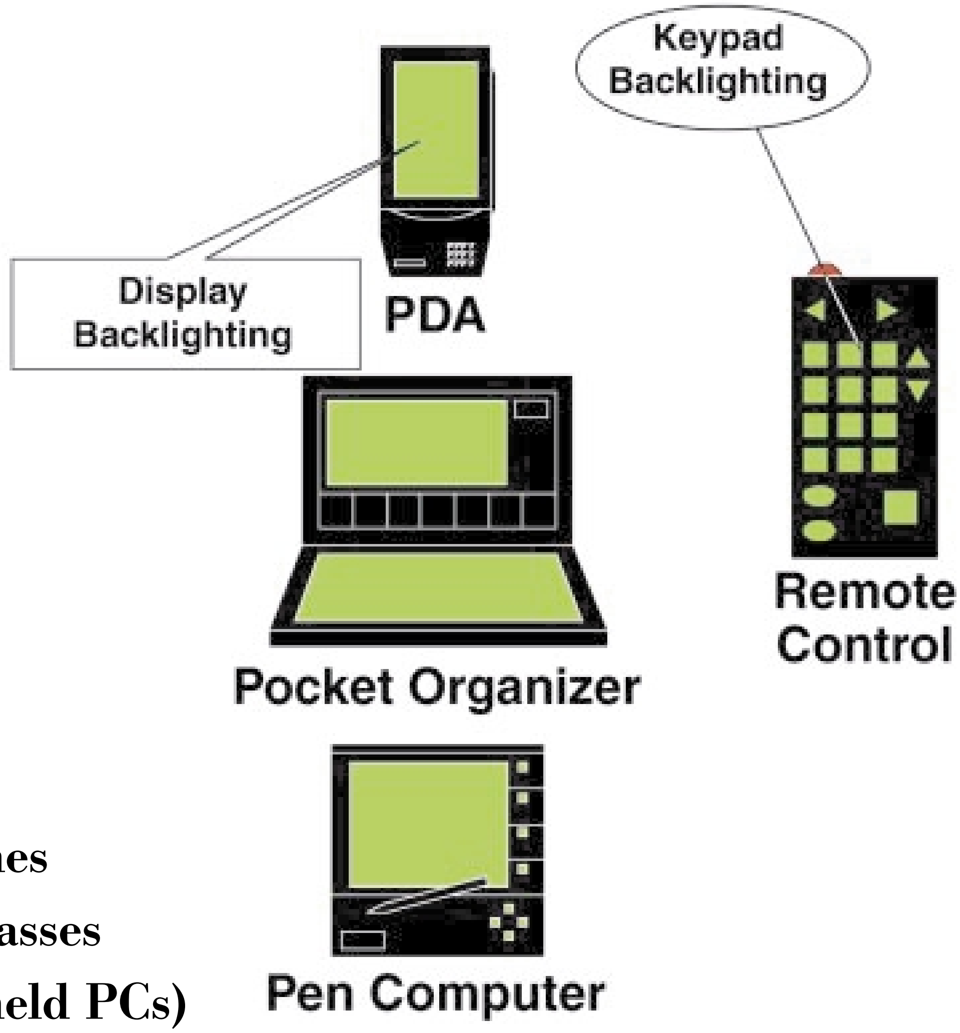
Electroluminescent Lamp Drivers

ISO 9001 Registered

EL Lamp Applications



- Pagers
- Caller ID
- Appliances
- Telephones
- Thermostats
- Weight Scales
- Cellular Phones
- Digital Compasses
- HPCs (Handheld PCs)
- Temperature Monitors
- Automotive Dashboards
- GPS Handheld Receivers
- PDAs (Personal Digital Assistants)
- Watches and Alarm Clocks
- Test and Medical Equipment
- TV/VCR/Audio/Cable Box Remote Controllers

IMP, Inc. - Company Profile

IMP, Inc. designs, manufacturers and markets standard-setting analog integrated circuits and specialty analog wafer foundry processes for data communications interface and power management applications in computer, communications and control systems. IMP products are sold through a worldwide network of representatives and distributors.

Company Facilities

IMP headquarters and ISO 9001 certified wafer fabrication and test facility are located in San Jose, California. A product development center is located in Pleasanton, California. The company employs 188 people.

Principal Markets

Data Communications Interface – Data communications components, such as PCM digital switch and Small Computer Systems Interface (SCSI) terminator integrated circuits.

Power Management – Devices to generate, distribute, protect and manage thermal and power consumption characteristics of desktop and portable computers, mobile and wireless communication devices, and battery powered electronic systems. Example products include electroluminescent lamp drivers, Universal Serial Bus (USB) power switches, microprocessor supervisors, low dropout voltage regulators, and high-frequency switching converters.

Wafer Fabrication and Manufacturing Services

High-volume, analog and mixed-signal wafer foundry services on low-power, high-voltage, CMOS, BiCMOS, Bipolar and EEPROM processes, including turnkey packaging and test capabilities. Fabrication services include database production using IMP standard processes, process development and porting of customer-owned technology.

For More Information

Visit the IMP web site at **www.impweb.com**; email **info@impinc.com** or contact IMP headquarters at 408.432.9100.

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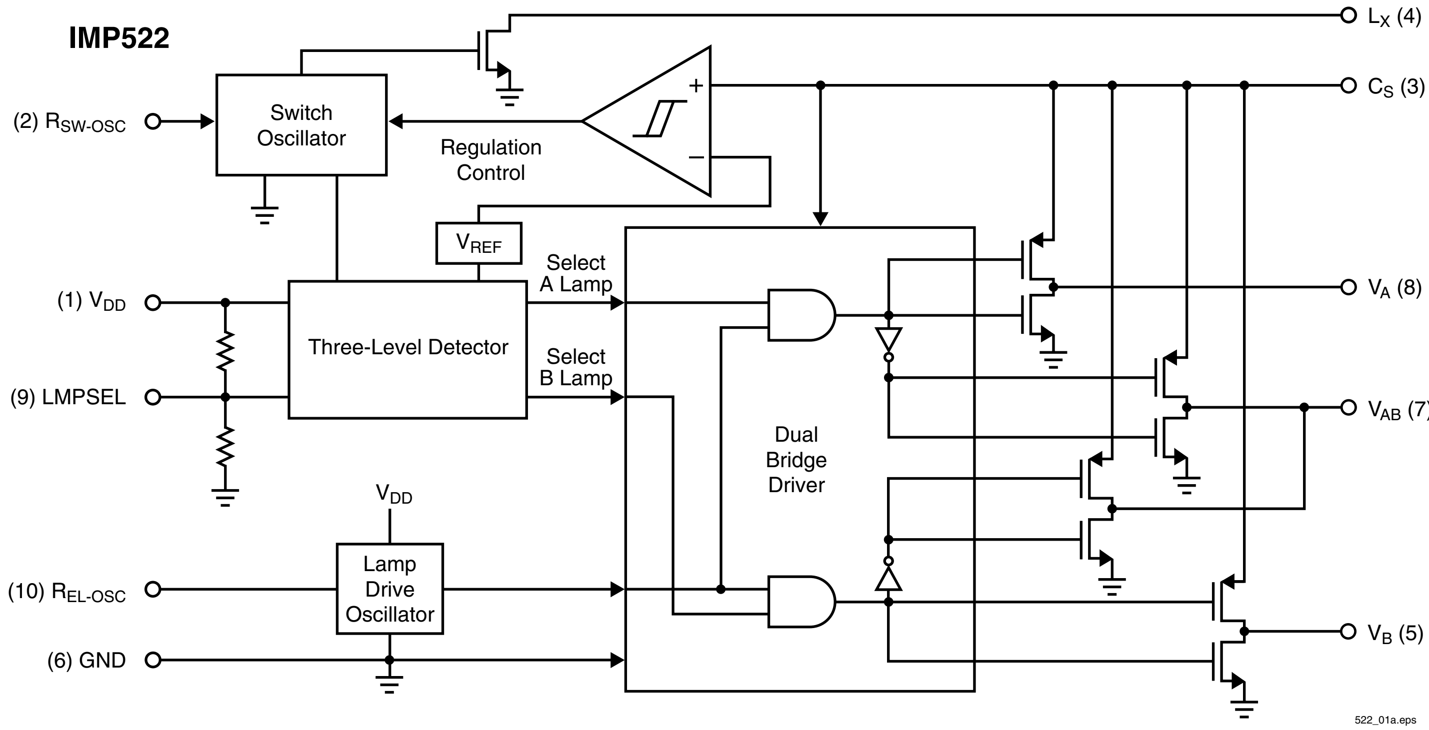
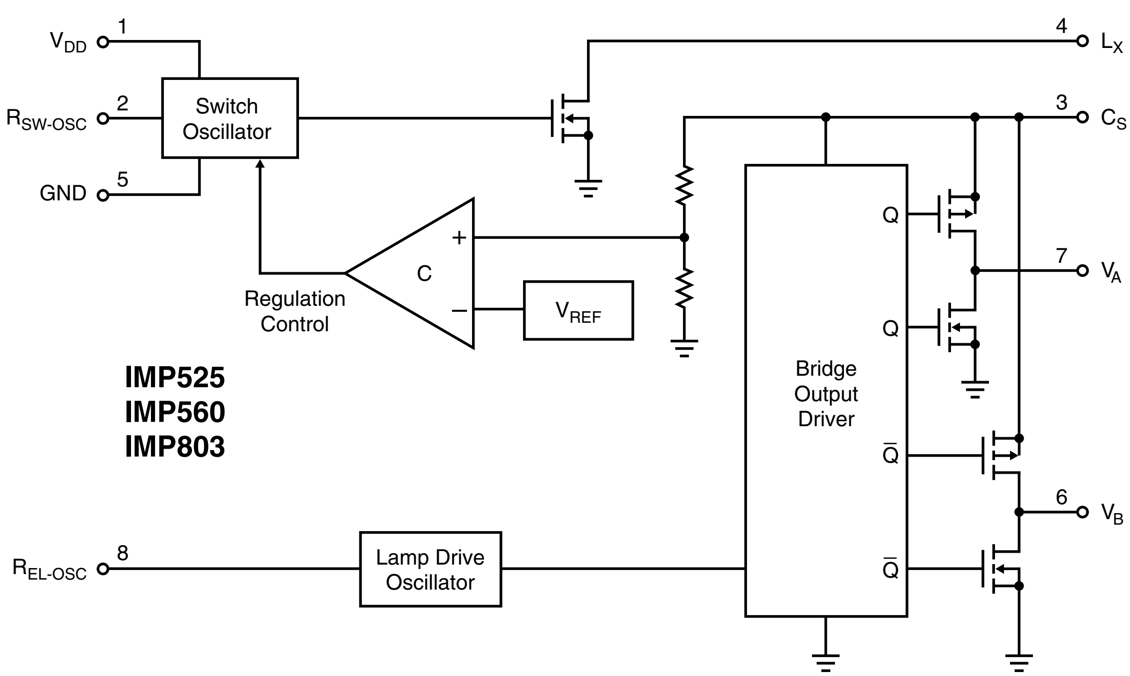
IMP Electroluminescent Lamp Drivers

IMP electroluminescent lamp drivers incorporate four EL lamp driving functions on-chip. These are the boost switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. Few external components are needed: one inductor, one diode, one capacitor and two resistors. The resistors allow independent adjustment of boost converter frequency and EL lamp drive frequency. Adjustable lamp drive frequency allows control over lamp color and power dissipation. All devices can be disabled for power saving.

All devices are available in chip form and small MicroSO and SO packages. Tape and reel shipment is available without additional cost.





IMP522: Dual-Output, High-Voltage Electroluminescent Lamp Driver

The IMP522 is a dual-output, high-voltage electroluminescent (EL) lamp driver. Either or both EL lamp driver outputs can be turned ON with the LMPSEL select pin. One EL lamp is connected between V_A and V_{AB} and the other is connected between V_B and V_{AB}. V_{AB} is a common pin for both lamps. With an input supply voltage between 2.0V and 6.5V, the typical regulated lamp drive voltage is 220V peak-to-peak.

The device uses a single inductor and a minimum number of passive components: a storage capacitor, a fast recovery diode and two resistors to set the PWM and EL drive frequencies. These can beindependently set to optimize brightness and minimize power consumption. R_{SW} is connected between the $R_{SW\text{-}OSC}$ pin and the supply pin V_{DD} to set the frequency for the internal 3.0Ω switching MOSFET. The switch duty cycle is 88%. The EL lamp driver frequency is set by R_{EL} connected between the $R_{EL\text{-}OSC}$ pin and the V_{DD} pin.

Designed to minimize battery current drain, the IMP522 draws 2mA maximum. A power-saving shutdown mode reduces current to 2µA maximum.

The IMP522 is available in a compact 10-pin MicroSO package and in die form.

Key Features

- Drive two EL lamps independently
- Digital LMPSEL pin
  - Activate either or both EL output drivers
- 220$V_{P\text{-}P}$ typical AC output voltage drives 30nF EL lamps
- Wide operating voltage range: 2V to 6.5V
- Low current consumption: 22mA maximum
- Disable mode extends battery life
  - Disable current 2µA maximum
- Compact 10-pin MicroSO package
- High-voltage, low-cost CMOS process

IMP525: Single Cell Battery Powered Electroluminescent Lamp Driver/Inverter

The IMP525 Electroluminescent (EL) lamp driver is designed for systems that must operate down to 1V and below. The input supply voltage range is 0.9V to 2.5V. Typical output lamp drive voltage is 112V peak-to-peak. EL lamps of up to 6nF capacitance can be driven to high brightness.

A disable mode puts the chip into a low current-drain state. When disabled, quiescent current drops to 1µA typical with a V_{DD} of 1.5V. Connecting R_{SW}, the oscillator frequency setting resistor, to ground, can disable the chip. A disable pad, accessible only on the die, can also be used to disable the driver (active low). An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 112V peak-to-peak. This conserves power and extends battery life.

Key Features

- Wide operating voltage range - from 0.9V to 2.5V
- Simple design requires few passive components
- 112V peak-to-peak typical AC output voltage
- Adjustable output frequency controls lamp color and power consumption
- Adjustable converter frequency minimizes circuit power consumption
- Disable mode extends battery life
- Disable current 1µA typical
- Compact MicroSO package and die option
- Same pinout as IMP803

IMP527: Single Cell Battery Powered Electroluminescent Lamp Driver/Inverter

The IMP527 is an Electroluminescent (EL) lamp driver designed for systems that must operate down to 1 volt and below. The input supply voltage range is 0.9V to 2.5V. Typical output lamp drive voltage is 180V. All four EL lamp-driving functions are on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. EL lamps of up to 6nF capacitance can be driven to high brightness.
The circuit requires few external components; one inductor, one diode, one capacitor and two resistors. The resistors set the frequency for the two oscillators.

A disable mode puts the chip into a low current-drain state. When disabled, quiescent current drops to 1µA typical with a V_{DD} of 1.5V. The chip can be disabled by connecting R_{SW}, the oscillator frequency setting resistor, to ground. A disable pad (active low), accessible only on the die, can also be used to disable the driver.

An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 180V peak-to-peak. This conserves power and extends battery life.

The IMP527 is available in MicroSO and SO-8 packages and in die form.

Key Features

- ◆ Wide operating voltage range - from 0.9V to 2.5V
- ◆ Simple design requires few passive components
- ◆ 180V peak-to-peak typical AC output voltage
- ◆ Adjustable output frequency controls lamp color and power consumption
- ◆ Adjustable converter frequency minimizes circuit power consumption
- ◆ Disable mode extends battery life
- ◆ Disable current 1µA typical
- ◆ Compact MicroSO package option

IMP528: High-Voltage EL Lamp Driver

The IMP528 is an Electroluminescent (EL) lamp driver with the four EL lamp driving functions on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. The IMP528 drives EL lamps of up to 50nF capacitance to high brightness; EL lamps with capacitances greater than 50nF can be driven, but will be lower in light output. The typical regulated output voltage that is applied to the EL lamp is 220V peak-to-peak. The circuit requires few external components; a single inductor, single diode, two capacitors and three resistors. Two of these resistors set the frequency for two internal oscillators.

Unlike other EL lamp drivers, the IMP528 does not require an external protection resistor in series with the EL lamp.

The IMP528 operates over a 2.0V to 6.5V supply voltage range. A regulated, low-power source can supply the low quiescent current of the IMP528. The inductor may be driven from an independent, unregulated supply voltage in dual supply applications.

An internal circuit shuts down the switching regulator when the lamp drive voltage reaches 220V peak-to-peak. This conserves power and extends battery life.

The IMP528 is available in MicroSO and SO-8 packages and in die or wafer form.

Key Features

- ◆ 220V peak-to-peak typical AC output voltage
- ◆ Low Power: 420µA typical V_{DD} current
- ◆ Wide operating voltage range - from 2.0V to 6.5V
- ◆ Large output load capability - drives lamps with more than 50nF capacitance
- ◆ Eliminates external protection resistor in series with EL lamp
- ◆ Adjustable output lamp frequency for control of lamp color, lamp life, and power consumption
- ◆ Adjustable converter frequency to minimize power consumption
- ◆ High-Voltage CMOS Process
- ◆ MicroSO package option

IMP560: Power Efficient EL Lamp Driver

The IMP560 is designed for systems with modest EL lamp drive voltage requirements. It is ideal for low ambient light applications or where small lamps are used. With just one-half the inductor current of the IMP803, the IMP560 reduces system power consumption and extends battery life. Input supply voltage range is 2.0V to 6.5V and quiescent current is a low 420µA. Typical EL lamp drive voltage is 120V peak-to-peak.

An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 120V peak-to-peak. This conserves power and extends battery life.

A disable mode puts the chip into a low current drain mode. With a 3.0V supply, quiescent current drops to 200nA maximum, 50nA typical.

Key Features

- 120V peak-to-peak typical AC output voltage
- Low input current (w/inductor current)......12mA
- Low disabled input current......50nA
- Wide operating voltage range - from 2.0V to 6.5V
- Simple design requires few passive components
- Adjustable output lamp frequency controls lamp color and power consumption
- Adjustable converter frequency for minimum power consumption
- IMP803 pin compatible
- MicroSO package option

IMP803: High-Voltage EL Lamp Driver

The IMP803 drives EL lamps of up to 30nF capacitance to high brightness. EL lamps with capacitance greater than 30nF can be driven but will be less bright. The typical regulated output voltage that is applied to the EL lamp is 180V peak-to-peak.

The IMP803 operates over a 2.0V to 6.5V supply voltage range. A regulated, low-power source can supply the low quiescent current of the IMP803. The inductor may be driven from an independent, unregulated supply voltage in dual supply applications. An internal circuit shuts down the switching regulator when the lamp drive voltage reaches 180V peak-to-peak. This conserves power and extends battery life.

Key Features

- Low Power: 420µA typical V_{DD} current
- Wide operating voltage range - from 2.0V to 6.5V
- 180V peak-to-peak typical AC output voltage
- Large output load capability - drive lamps with more than 30nF capacitance
- Adjustable output lamp frequency for control of lamp color, lamp life, and power consumption
- Adjustable converter frequency to minimize power consumption
- Device can be Enabled/Disabled
- Low quiescent current - 20nA (disabled)
- High-Voltage CMOS Process
- MicroSO package option

EL Lamp Driver Product Summary Table

Part	Input Voltage Range (V)	Typical Output Voltage (V_{PP})	Regulated Output Voltage	Adjustable Lamp Drive and Boost Frequency	Low Power Disable Mode	Packages
IMP522	2.0 to 6.5	220 (Dual Outputs)	Yes	Yes	Yes	10-pin, MicroSO
IMP525	0.9 to 2.5	112	Yes	Yes	Yes	8-pin, MicroSO & SO
IMP527	0.9 to 2.5	180	Yes	Yes	Yes	8-pin, MicroSO & SO
IMP528	2.0 to 6.5	220	Yes	Yes	Yes	8-pin, MicroSO & SO
IMP560	2.0 to 6.5	120	Yes	Yes	Yes	8-pin, MicroSO & SO
IMP803	2.0 to 6.5	180	Yes	Yes	Yes	8-pin, MicroSO & SO

Die are also available.

ELD/B_t06

EL Lamp Driver Development Kits

Several demonstration boards and evaluation kits are available to reduce time-to-market. The kits are available by calling IMP Customer Service at 408.432.9100.

Item	Device/Package	Description
IMP803EV1	IMP803LG	Evaluation board.
IMPxxxDBM	Any MicroSO	Development board. For evaluating IC sample(s) in-circuit.
IMPxxxDBS	Any SO	Development board. For evaluating IC sample(s) in-circuit.

Note: "xxx" denotes any driver; 525, 527, 528, 560 or 803.

ELD/B_t05

Electroluminescent Lamp Applications and Benefits

Liquid Crystal Displays (LCDs) must be lighted for viewing in darkness or low ambient light conditions. Typically, light is projected forward from the back of the LCD display. EL lamps are popular backlights for liquid crystal displays and keypads because EL lamps are flexible, lightweight, thin, vibration and impact resistant, and can be shaped into small, complex or irregular forms. EL lamps evenly light an area without creating "bright-spots".

Since EL lamps typically consume much less current than incandescent bulbs or light emitting diodes (LEDs), their low power consumption, low heat generation and flexibility make them ideal for battery powered portable applications.

EL lamp backlighting applications include: keyless entry systems; audio/video equipment remote controllers; PDA keyboards and displays; timepieces and watches; LCD displays in cellular phones, pagers, and handheld Global Positioning Systems (GPS); face illumination for instrumentation; assistance lighting for buildings; and decorative lighting for sign-displays and merchandising displays.

Typical EL Lamp Applications

- PDAs
- Safety illumination
- Portable instrumentation
- Battery-operated displays
- LCD modules
- Toys
- Automotive displays
- Cellular phones
- Night lights
- Audio and TV remote control units
- Panel meters
- Pagers
- Clocks and radios
- Portable GPS receivers
- Handheld computers
- Caller ID

EL Driver Product Updates

New product information and application notes can be obtained by visiting the IMP web site at **www.impweb.com** or by sending email to **info@impinc.com**.

Dual EL Lamp Driver

The IMP522 is a dual-output, high-voltage electroluminescent (EL) lamp driver. Either or both EL lamp driver outputs can be turned ON with the LMPSEL select pin. One EL lamp is connected between V_A and V_{AB} and the other is connected between V_B and V_{AB}. V_{AB} is a common pin for both lamps. With an input supply voltage between 2.0V and 6.5V, the typical regulated lamp drive voltage is 220V peak-to-peak.

The device uses a single inductor and a minimum number of passive components: a storage capacitor, a fast recovery diode and two resistors to set the PWM and EL drive frequencies. These can be independently set to optimize brightness and minimize power consumption. R_{SW} is connected between the $R_{SW\text{-}OSC}$ pin and the supply pin V_{DD} to set the frequency for the internal 3.0Ω switching MOSFET. The switch duty cycle is 88%. The EL lamp driver frequency is set by R_{EL} connected between the $R_{EL\text{-}OSC}$ pin and the V_{DD} pin.

Designed to minimize battery current drain, the IMP522 draws 2mA maximum. A power-saving shutdown mode reduces current to 2μA maximum.

The IMP522 is available in a compact 10-pin MicroSO package and in die form.

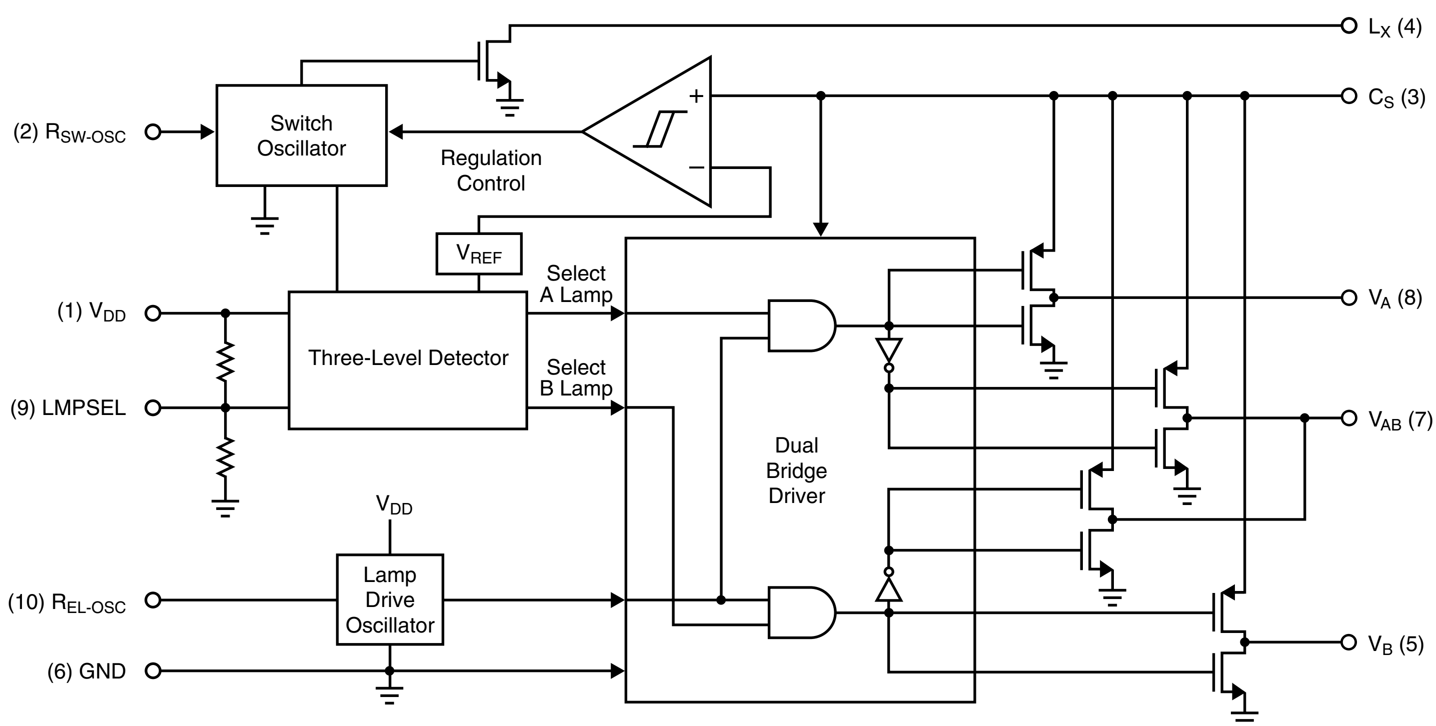
Key Features

- Drive two EL lamps independently
- Digital LMPSEL pin
  - Activate either or both EL output drivers
- 220$V_{P\text{-}P}$ typical AC output voltage drives 30nF EL lamps
- Wide operating voltage range: 2V to 6.5V
- Low current consumption: 2mA maximum
- Disable mode extends battery life
  - Disable current 2μA maximum
- Compact 10-pin MicroSO package
- High-voltage, low-cost CMOS process

Applications

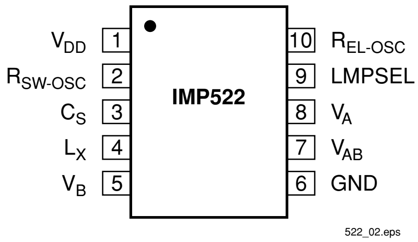
- Cellular phones
- PDAs/Handheld computers
- Toys/Consumer electronics
- Safety Illumination
- LCD modules
- Remote controls

Block Diagram



Pin Configuration

MicroSO



Ordering Information

Part Number	Input Voltage	Temperature Range	Pins-Package
IMP522EMB	2.0V to 6.5V	−40°C to +85°C	10-MicroSO

Add /T to ordering part number for Tape and Reel.

Absolute Maximum Ratings

V_{DD}, $R_{SW\text{-}OSC}$ and $R_{EL\text{-}OSC}$ . . . . –0.5V to +7.0V
C_S, L_X . . . . –0.5V to +120V
Operating Temperature Range . . . . –40°C to +85°C
Storage Temperature Range . . . . –65°C to +150°C
Power Dissipation (MicroSO) 500mW
V_A, V_B, V_{AB} . . . . –0.5V to V_{CS} (pin 3)

Note: All voltages are referenced to GND.

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

Electrical Characteristics

Unless otherwise noted, V_{DD} = 3.0V, R_{SW} = 910kΩ, R_{EL} = 2.7MΩ, L = 220µH and T_A = 25°C.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
ON-resistance of MOS Switch	$R_{DS(ON)}$	I = 100mA		3.5	8	Ω
Output Voltage Regulation	V_{CSREG}			110	120	V
Output Voltage Peak-to-Peak (in regulation)	V_A-V_{AB}, V_B-V_{AB}	V_{DD} = 2.0 to 6.5V		220		V
Output Drive Frequency (either output)	f_{EL}	See Figure 1			2	µA
Switching Frequency	f_{SW}	See Figure 1		61		kHz
Switching Duty Cycle	D_{SW}	See Figure 1		88		%
Input Current:						
I_{DD} Without Inductor Current	I_{IN0}	See Figure 1		1.0	2.0	mA
I_{DD} Plus Inductor Current (1 Load)	I_{IN1}	See Figure 1		21	31	
I_{DD} Plus Inductor Current (2 Load)	I_{IN2}	See Figure 1		TBD	TBD	

Pin Descriptions

Pin Number	Name	Function
1	V_{DD}	Positive voltage supply. Inductor L may be connected here or to a separate unregulated supply.
2	$R_{SW\text{-}OSC}$	Switch-mode resistor pin. The external resistor R_{SW} determines switching frequency.
3	C_S	Boost converter storage capacitor. The voltage across the EL lamp is approximately equal to twice the voltage at C_S.
4	L_X	Connection to flyback inductor L.
5	V_B	Output for EL Lamp B.
6	GND	Ground.
7	V_{AB}	Common terminal for both EL lamps.
8	V_A	Output for EL Lamp A.
9	LMPSEL	Digital three-state input pin. Select either lamp A or lamp B or both lamps.
10	$R_{EL\text{-}OSC}$	The EL lamp oscillator frequency setting pin. External resistor R_{EL} connected to V_{DD} sets the EL Lamp drive frequency for both lamps.

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Application Information

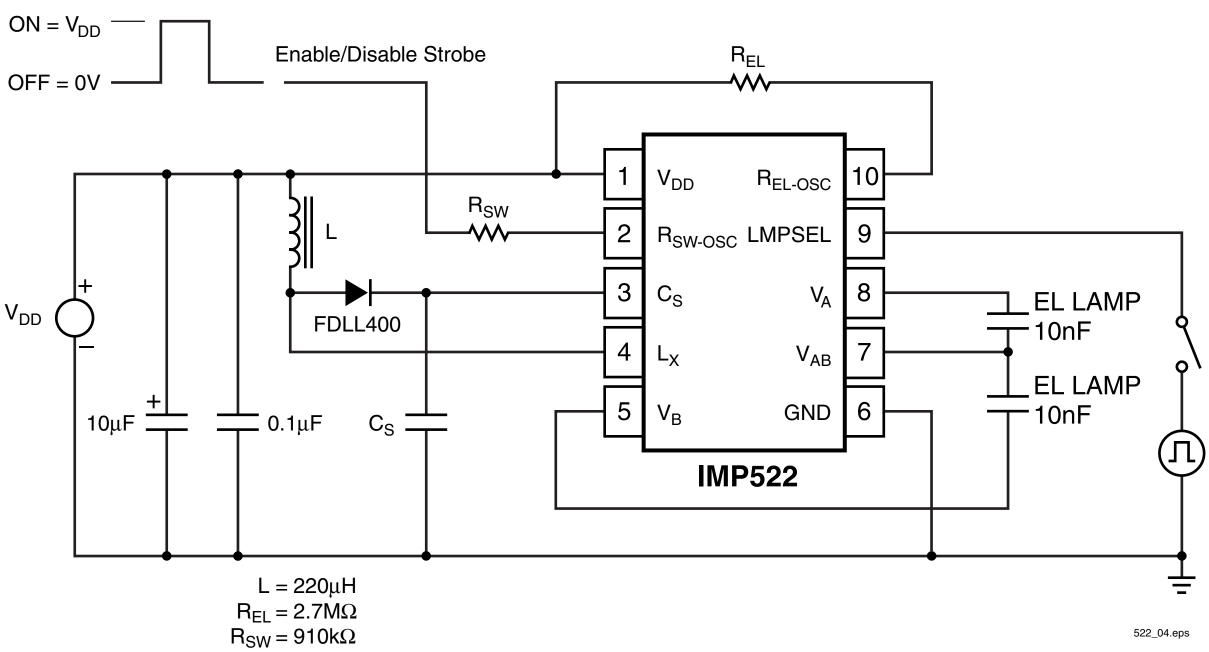

Figure 1. Test Circuit

Application Information

EL Lamp Drive

The outputs $V_A - V_{AB}$ and $V_B - V_{AB}$ are configured as H-bridges, driven by the EL oscillator. Each output is switched between C_S and ground on alternate phases, creating peak-to-peak signals across the EL lamps of twice the regulated voltage.

EL Lamp Selection: LMPSEL

The digital input pin LMPSEL allows either or both EL lamps to be active. Lamp A is active when LMPSEL is LOW and lamp B is active when LMPSEL is HIGH. When LMPSEL is left floating or driven by a three-state driver in the high impedance state, both lamp driver outputs are active.

LMPSEL Signal	Lamp A Drive V_A and V_{AB}	Lamp B Drive V_B and V_{AB}
HIGH	OFF	ON
LOW	ON	OFF
Floating/ High Impedance	ON	ON

522_t02.eps

The logic HIGH signal level is defined as greater than $0.7V_{DD}$ and logic LOW is defined as less than $0.3V_{DD}$. A floating level is recognized with the signal level between $0.3V_{DD}$ and $0.7V_{DD}$, or when the output impedance of the driving voltage signal source is infinite (driver in OFF state).

Both drivers are OFF if the IMP522 is disabled.

EL Driver Output Overvoltage Regulator

The IMP522 maximum V_{CS} output voltage is between 110V and 120V. The internal overvoltage regulator skips the inductor switching whenever the voltage on the C_S pin exceeds the regulation threshold. The internal overvoltage detection trip point has a hysterisis of 1V and a range of 110V to 120V at room temperature.

PWM Circuit Switching

The switching MOSFET is driven by the PWM signal (nominally 61kHz). During the first 88% of the period, the switch is ON, providing a low impedance path (<8Ω) from L_X to ground. This causes the external inductor to charge. In the last 12% of the period, the MOSFET is turned OFF. This causes the voltage on the output of L_X to rise up to a high value. At some point, this will forward-bias the external diode, thus pumping charge into the storage capacitor C_S. The voltage on C_S increases each cycle to between 110V and 120V. When the internal regulation trip-point is reached, the overvoltage regulator turns the MOSFET switch OFF to conserve power.

Application Information

Power Sequencing

To power up the chip, the R_{SW-OSC} pin is connected to V_{DD} through the external R_{SW} resistor. The voltage on the pin will charge up to $V_{DD}/2$. An internal threshold detector circuit monitors the pin voltage and when it exceeds the threshold range (0.2V to 0.9V) it powers up the oscillator and internal bias modules. This starts a delay counter which is one half of the EL oscillator period, after which power to the high voltage internal modules is applied. The IMP522 is then operating fully.

To power down the chip, R_{SW} is driven to ground via a switch or logic gate. When the voltage on the driver side of the resistor falls below $V_{DD}/2$, there will be no input bias current into the R_{SW-OSC} pin. This immediately powers down the internal high-voltage circuits, which effectively shuts the lamp off. At this point the oscillator and bias modules still draw quiescent current, but oscillations have ceased. As the R_{SW-OSC} pin voltage falls below 0.1, the oscillator and bias modules are also fully powered down.

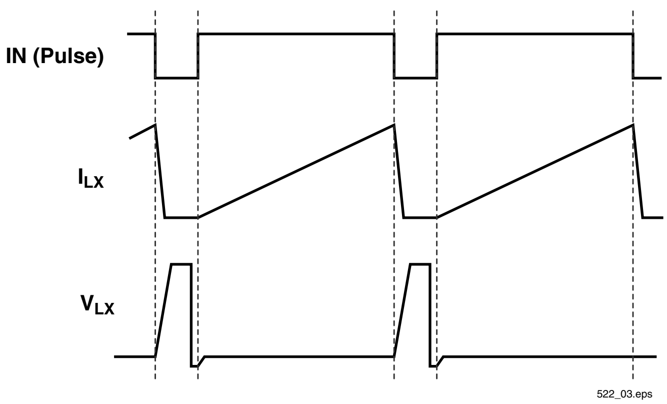

Figure 1. Driver Waveforms

Power Saving Disable Mode

The IMP522 can be powered up and down with R_{SW-OSC}. In normal operation, this resistor on the R_{SW-OSC} pin is connected to V_{DD} or another voltage source. To power down (disable) the IMP522, R_{SW} is connected to ground.

When disabled, the IMP522 quiescent current drops to typically 20nA.

In die form, an extra pin $\overline{\text{ENABLE}}$ is available (contact factory). Connecting this pad to V_{DD} disables the chip. The $\overline{\text{ENABLE}}$ signal can be driven by a microcontroller.

Oscillator Frequency Adjustment

The EL lamp drive and PWM boost converter oscillation frequencies can be programmed independently.

The R_{SW} resistor, connected between the R_{SW-OSC} pin and V_{DD}, determines the Inductor Switching (or PWM-) frequency. For the recommended nominal resistor value of 910kΩ, the frequency is 61kHz. For other resistor values, the frequency is inversely proportional to the resistor value. Increasing the resistance will lower the frequency.

The R_{EL} resistor, connected between the R_{EL-OSC} pin and V_{DD}, determines the EL lamp drive frequency. For the recommended nominal resistor value of 2.7MΩ, the frequency is 250Hz. For other resistor values, the frequency is inversely proportional to the resistor value: increasing the resistance will lower the frequency.

Oscillator	Nominal Resistor	Nominal Frequency
EL Lamp Drive	R_{EL} = 2.7MΩ	250Hz
Inductor Switch (PWM)	R_{SW} = 910kΩ	61kHz

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Notes

Project

Single Cell Battery Powered Electroluminescent Lamp Driver/Inverter

The IMP525 is an Electroluminescent (EL) lamp driver designed for systems that must operate down to 1 volt and below. The input supply voltage range is 0.9V to 2.5V. Typical output lamp drive voltage is 112V. All four EL lamp-driving functions are on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. EL lamps of up to 6nF capacitance can be driven to high brightness.

The circuit requires few external components; one inductor, one diode, one capacitor and two resistors. The resistors set the frequency for the two oscillators.

A disable mode puts the chip into a low current-drain state. When disabled, quiescent current drops to 1µA typical with a V_{DD} of 1.5V. The chip can be disabled by connecting R_{SW}, the oscillator frequency setting resistor, to ground. A disable pad (active low), accessible only on the die, can also be used to disable the driver.

An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 112V peak-to-peak. This conserves power and extends battery life.

The IMP525 is available in MicroSO and SO-8 packages and in die form.

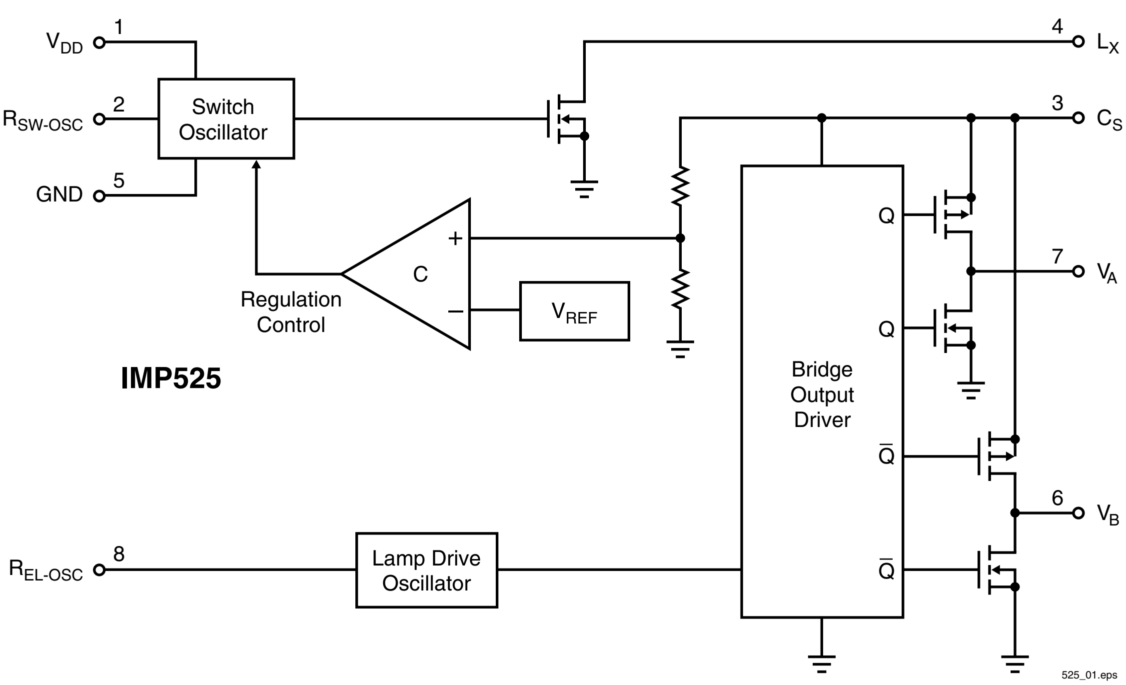
Key Features

- Wide operating voltage range - from 0.9V to 2.5V
- Simple design requires few passive components
- 112V peak-to-peak typical AC output voltage
- Adjustable output frequency controls lamp color and power consumption
- Adjustable converter frequency minimizes circuit power consumption
- Disable mode extends battery life
- Disable current 1µA typical
- Compact MicroSO package option

Applications

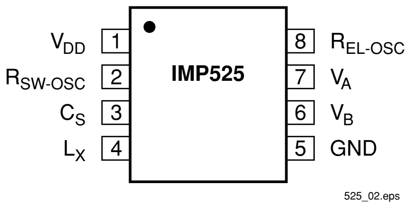
- Audio/TV remote control units
- Pagers/Cellular phones
- PDAs
- Clocks and radios
- Portable GPS receivers
- LCD modules
- Toys

Block Diagram



Pin Configuration

SO/MicroSO



Ordering Information

Part Number	Input Voltage	Regulated Output Voltage	Temperature Range	Pins-Package
IMP525EMA	0.9V to 2.5V	YES	−40°C to +85°C	8-MicroSO
IMP525ESA	0.9V to 2.5V	YES	−40°C to +85°C	8-SO
IMP525/D*	0.9V to 2.5V	YES	25°C	Dice
IMP525/D1**	0.9V to 2.5V	YES	25°C	Dice

** Disable pad not active*
*** Disable pad active*
Add /T to ordering part number for Tape and Reel.

Absolute Maximum Ratings

Supply Voltage, V_{DD}, $V_{RSW\text{-}OSC}$ and $V_{REL\text{-}OSC}$ . . −0.5V to +3.5V
Storage Temperature Range . . . . −65°C to +150°C
Power Dissipation (SO package) 400mW
Power Dissipation (MicroSO package) 300mW

Note: All voltages are referenced to GND.

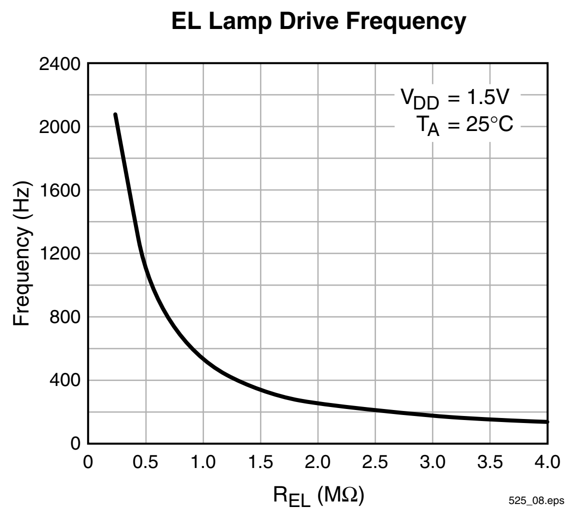
These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

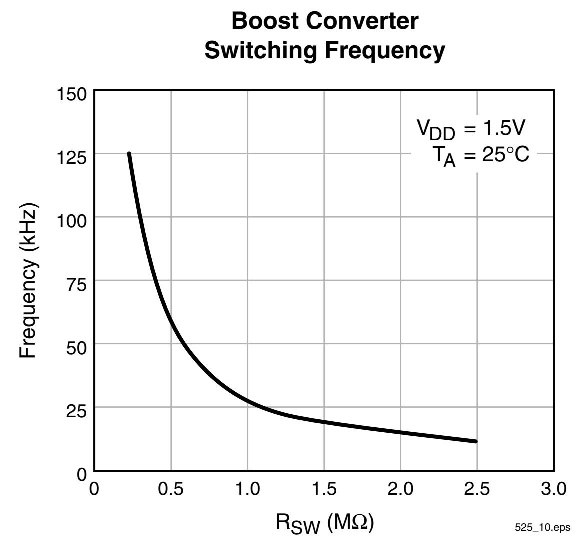
Electrical Characteristics

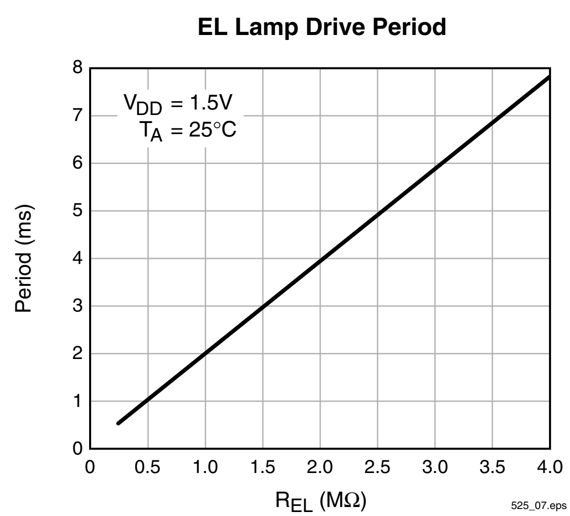
Unless otherwise noted, V_{DD} = 1.5V, R_{SW} = 1MΩ, R_{EL} = 1.0MΩ, and T_A = 25°C.

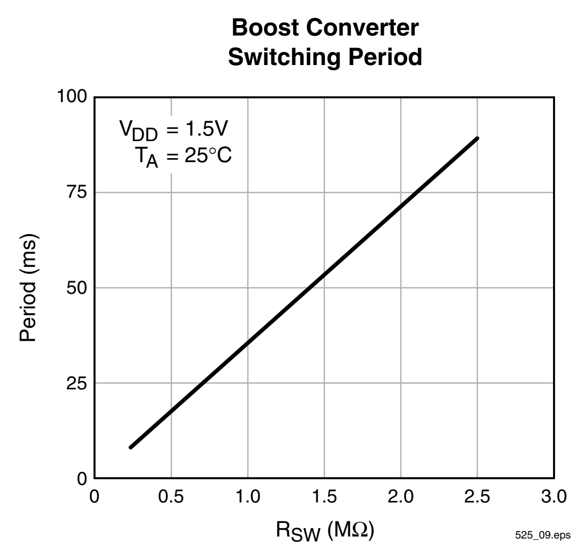
Parameter	Symbol	Conditions	Min	Typ	Max	Units
ON-resistance of MOS Switch	$R_{DS(ON)}$	I = 50mA			15	Ω
Operating Voltage			0.9		2.5	V
Output Voltage at C_S	V_{CS}	V_{DD} = 1.5V, See Figure 1, Table 1	52	58	65	V
Output Voltage at C_S	V_{CS}	V_{DD} = 0.9V, See Figure 1, Table 2		50		V
Output Voltage Peak-to-Peak	V_A-V_B	V_{DD} = 1.5V, See Figure 1	104	112	124	$V_{P\text{-}P}$
Quiescent V_{DD} Supply Current, Disabled (Disable pin available on die only)	I_{QDIS}	Disable = HIGH		70		nA
Quiescent V_{DD} Supply Current, Disabled	I_{QDIS}	$R_{SW\text{-}OSC}$ = GND V_{DD} = 1.5V		1.0	2.0	µA
Input Current at V_{DD} Pin	I_{DD}	V_{DD} = 0.9V to 1.5V			1.5	mA
Input Current: I_{DD} Plus Inductor Current	I_{IN}	V_{DD} = 1.5V		23	32	mA
$V_{A\text{-}B}$ Output Drive Frequency	f_{EL}	V_{DD} = 1.5V, See Figure 1, Table 1		500		Hz
Boost Converter Switching Frequency	f_{SW}	V_{DD} = 1.5V, See Figure 1, Table 1		26		kHz
Switching Duty Cycle	D_{SW}	V_{DD} = 1.5V, See Figure 1		87.5		%
Disable Input LOW Voltage (Disable pin available on die only)	V_{DISL}		GND		0.2	V
Disable Input HIGH Voltage (Disable pin available on die only)	V_{DISH}		V_{DD}-0.5V		V_{DD}	V

Typical Characteristics









Pin Descriptions

Pin Number	Name	Function
1	V_{DD}	Positive voltage supply for the IMP525. Inductor L may be connected here or to a separate supply.
2	$R_{SW\text{-}OSC}$	Switch-mode resistor pin. Switching frequency is determined by external resistor R_{SW}, connected between pin 2 and V_{DD}.
3	C_S	Boost converter storage capacitor. The voltage across the EL lamp is equal to twice the voltage at C_S.
4	L_X	Connection to flyback inductance, L.
5	GND	Ground pin.
6	V_B	EL lamp drive. The lamp is connected to a high-voltage bridge circuit with V_B providing the complementary connection to V_A.
7	V_A	EL lamp drive. (See above)
8	$R_{EL\text{-}OSC}$	The EL lamp oscillator frequency-setting pin. The frequency is controlled by resistor R_{EL}, connected from pin 8 to V_{DD}.
Disable Pad	DIS	Available only in die form. Setting DIS HIGH disables the chip.

External Components

External Component	Description and Selection Guide
Diode	A fast reverse recovery diode, with BV > 100, such as a 1N4148.
Capacitor C_S	The high voltage capacitor that stores the inductive energy transferred through the catch diode. A 100 volt capacitor between 10nF and 100nF is recommended.
Resistor R_{EL}	The EL lamp oscillator frequency-setting resistor. R_{EL} is connected between pin 8 and V_{DD}, providing a frequency inversely proportional to R_{EL}; as R_{EL} increases, the EL lamp frequency decreases along with the current drawn by the lamp. Lamp color is also determined by this frequency. A 1MΩ resistor between the $R_{EL\text{-}OSC}$ pin and the V_{DD} supply results in a lamp frequency around 500Hz.
Resistor R_{SW}	Switching Oscillator frequency-setting resistor. R_{SW} is connected between the $R_{SW\text{-}OSC}$ pin and the V_{DD} supply. The switching frequency is inversely proportional to the resistor value, dropping as the resistance increases.
Capacitor C_{SW}	This is an optional noise-suppression capacitor connected from ground to the $R_{SW\text{-}OSC}$ pin. A 100pF capacitor is recommended.
Inductor L	The inductor provides the voltage boost needed by means of inductive “flyback”. The internal MOSFET switch alternately opens and closes the ground connection for the inductor at the L_X pin. When the switch opens, the inductor potential will forward-bias the diode and the current will pass through to the storage capacitor C_S, charging it to a high voltage. As the value of the inductor is increased, the switching frequency set by R_{SW} should also be increased to prevent saturation. In general, smaller value inductors that can handle more current are more desirable when larger-area EL lamps must be driven. A small electrolytic capacitor (10µF, 16V), normally present across the inductor supply V_{IN}, will likely eliminate the need for C_{SW}.

Application Information

Test Circuit

Figure 1 shows the IMP525 configured to drive an EL lamp, represented as a 3nF capacitor.

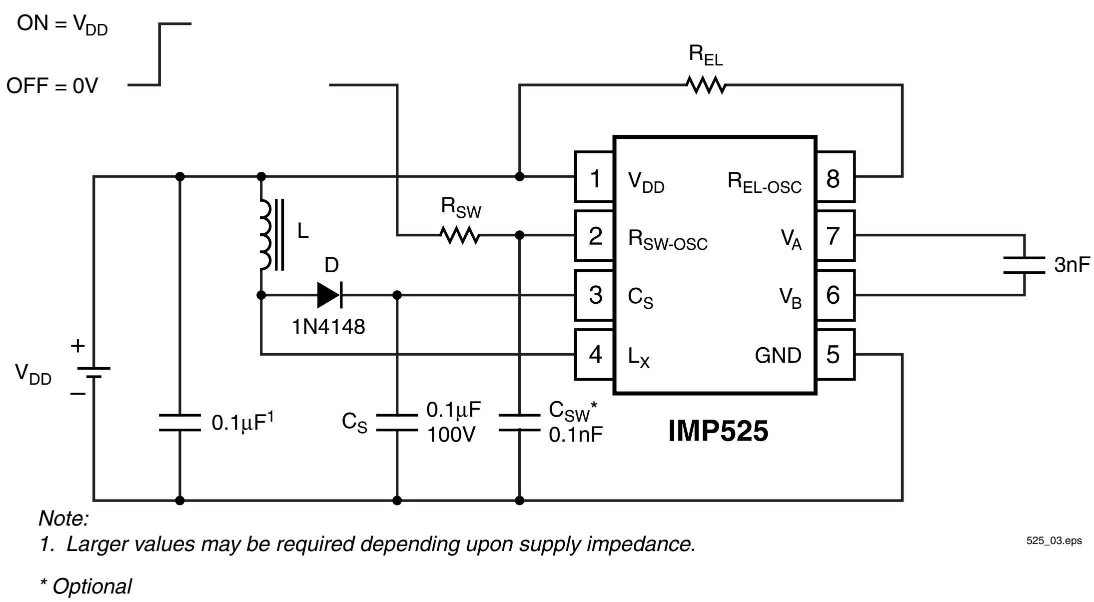


Figure 1. Test Circuit

Table 1. V_{IN} = 1.5V

Component	Connections	Value	Description
R_{SW}	V_{DD}, $R_{SW\text{-}OSC}$	1MΩ	Boost converter oscillator bias resistor
R_{EL}	V_{DD}, $R_{EL\text{-}OSC}$	1MΩ	EL lamp driver oscillator bias resistor
L	V_{DD}, L_X[2]	330µH[2]	Boost converter inductor
C_S	C_S, GND	0.1µF/100V	Boost converter storage capacitor
D	L_X, C_S	1N4148	Switching diode
C_{SW}	$R_{SW\text{-}OSC}$, GND	0.1nF	Noise-suppression capacitor

Notes. 2. Murata LQH4N331K04 (8.2Ω max. DCR)

Table 2. V_{IN} = 0.9V

Component	Connections	Value	Description
R_{SW}	V_{DD}, $R_{SW\text{-}OSC}$	1.0MΩ	Boost converter oscillator bias resistor
R_{EL}	V_{DD}, $R_{EL\text{-}OSC}$	2.62MΩ	EL lamp driver oscillator bias resistor
L	V_{DD}, L_X[3]	680µH[3]	Boost converter inductor
C_S	C_S, GND	0.1µF/100V	Boost converter storage capacitor
D	L_X, C_S	1N4148	Switching diode
C_{SW}	$R_{SW\text{-}OSC}$, GND	0.1nF	Noise-suppression capacitor

Notes. 3. Coilcraft DS1608C-684 (2.2Ω max. DCR)

Enable/Disable Operation

Figure 2 shows how the IMP525 can be enabled via a logic gate that connects R_{SW} to V_{DD}, and disabled by connecting it to ground.

The IMP525 can also be disabled using a pad on the die. The Disable function pin is not available in packaged parts.

Enable/Disable Table	
R_{SW} Connection	IMP525 State
V_{DD}	Enabled
Ground	Disabled

Disable PAD Connection (Available only with dice)	IMP525 State
HIGH (V_{DD})	Disabled
LOW (Ground)	Enabled

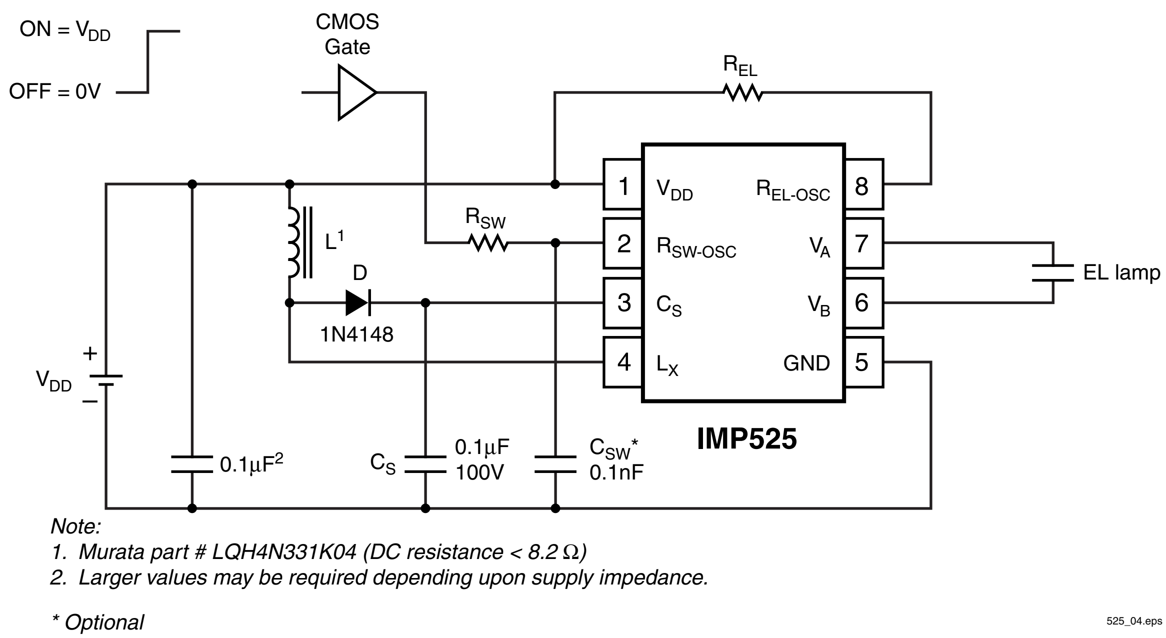


Figure 2. Enable/Disable Operation

High Voltages Present

The IMP525 generates high voltages and caution should be exercised.

Inductor Manufacturers

Manufacturer	Series	USA Phone Number
Toko	D52FU	(847) 297-0070
Coilcraft	DS1608, DO1608, DT1608	(847) 639-6400
River Electronics	FLC32	(310) 320-7488
Murata	LQH4N	(800) 831-9172

Single Cell Battery Powered Electroluminescent Lamp Driver/Inverter

The IMP527 is an Electroluminescent (EL) lamp driver designed for systems that must operate down to 1 volt and below. The input supply voltage range is 0.9V to 2.5V. Typical output lamp drive voltage is 180V. All four EL lamp-driving functions are on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. EL lamps of up to 6nF capacitance can be driven to high brightness.

The circuit requires few external components; one inductor, one diode, one capacitor and two resistors. The resistors set the frequency for the two oscillators.

A disable mode puts the chip into a low current-drain state. When disabled, quiescent current drops to 1µA typical with a V_{DD} of 1.5V. The chip can be disabled by connecting R_{SW}, the oscillator frequency setting resistor, to ground. A disable pad (active low), accessible only on the die, can also be used to disable the driver.

An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 180V peak-to-peak. This conserves power and extends battery life.

The IMP527 is available in MicroSO and SO-8 packages and in die form.

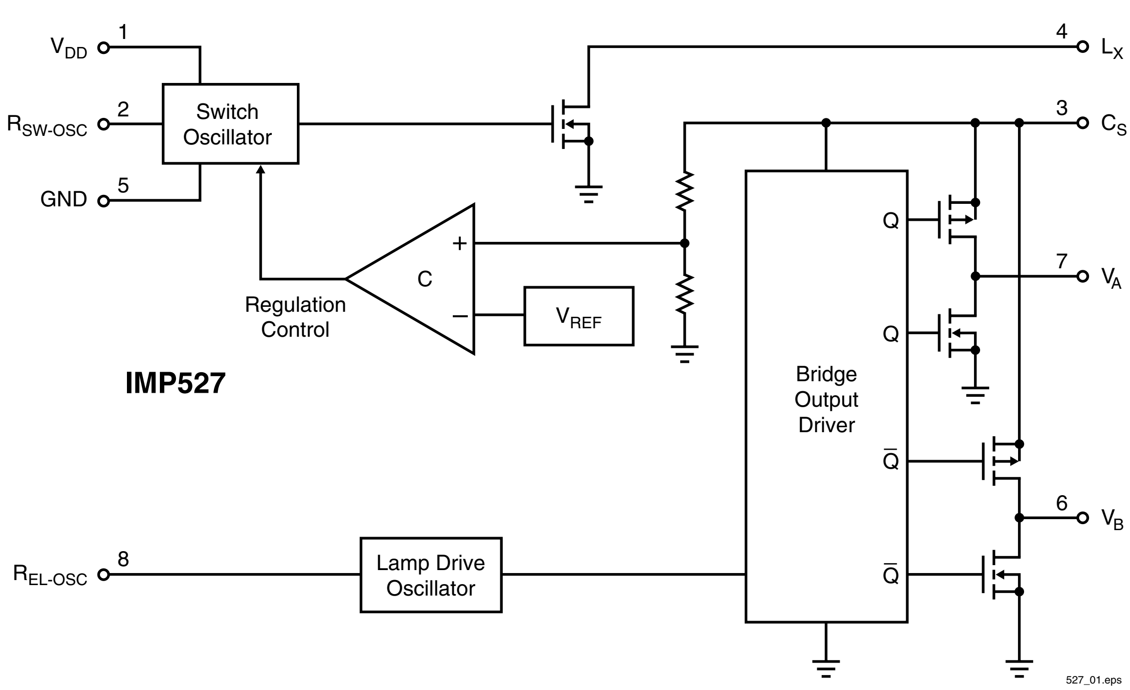
Key Features

- Wide operating voltage range - from 0.9V to 2.5V
- Simple design requires few passive components
- 180V peak-to-peak typical AC output voltage
- Adjustable output frequency controls lamp color and power consumption
- Adjustable converter frequency minimizes circuit power consumption
- Disable mode extends battery life
- Disable current 1µA typical
- Compact MicroSO package option

Applications

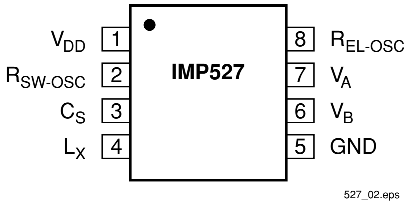
- Audio/TV remote control units
- Pagers/Cellular phones
- PDAs
- Clocks and radios
- Portable GPS receivers
- LCD modules
- Toys

Block Diagram



Pin Configuration

SO/MicroSO



Ordering Information

Part Number	Input Voltage	Regulated Output Voltage	Temperature Range	Pins-Package
IMP527EMA	0.9V to 2.5V	YES	–40°C to +85°C	8-MicroSO
IMP527ESA	0.9V to 2.5V	YES	–40°C to +85°C	8-SO
IMP527/D*	0.9V to 2.5V	YES	25°C	Dice
IMP527/D1**	0.9V to 2.5V	YES	25°C	Dice

* *Disable pad not active*
** *Disable pad active*

Absolute Maximum Ratings

Supply Voltage, V_{DD}, $V_{RSW\text{-}OSC}$ and $V_{REL\text{-}OSC}$ . . –0.5V to +3.5V
Storage Temperature Range . . . . –65°C to +150°C
Power Dissipation (SO package) 400mW
Power Dissipation (MicroSO package) 300mW

Note: All voltages are referenced to GND.

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

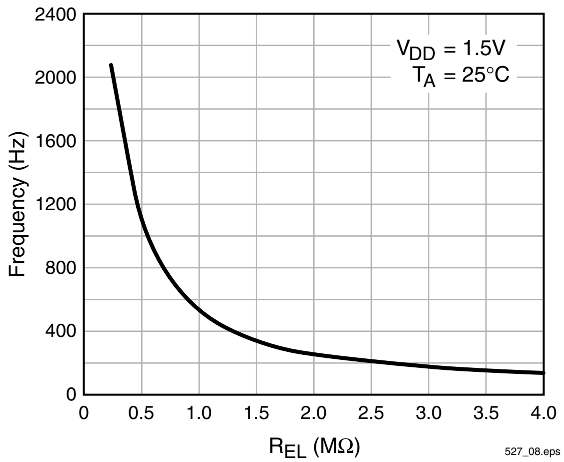
Electrical Characteristics

Unless otherwise noted, V_{DD} = 1.5V, R_{SW} = 1MΩ, R_{EL} = 1MΩ, and T_A = 25°C.

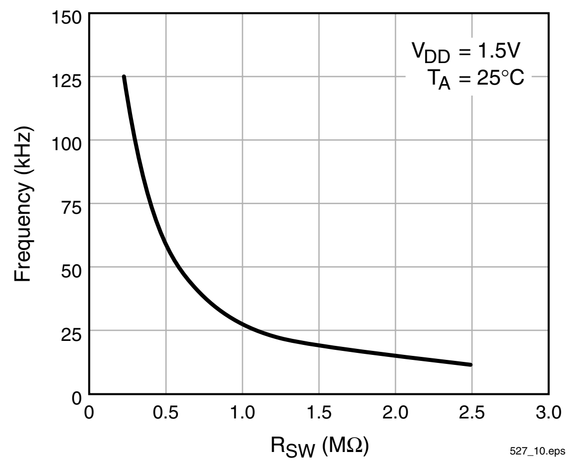
Parameter	Symbol	Conditions	Min	Typ	Max	Units
ON-resistance of MOS Switch	$R_{DS(ON)}$	I = 50mA			15	Ω
Operating Voltage			0.9		2.5	V
Output Voltage at C_S	V_{CS}	V_{DD} = 1.5V, See Figure 1, Table 1	80	90		V
Output Voltage at C_S	V_{CS}	V_{DD} = 0.9V, See Figure 1, Table 2		50		V
Output Voltage Peak-to-Peak	V_A-V_B	V_{DD} = 1.5V, See Figure 1		180		$V_{P\text{-}P}$
Quiescent V_{DD} Supply Current, Disabled (Disable pin available on die only)	I_{QDIS}	Disable = HIGH		70		nA
Quiescent V_{DD} Supply Current, Disabled	I_{QDIS}	$R_{SW\text{-}OSC}$ = GND V_{DD} = 1.5V		1.0	2.0	µA
Input Current at V_{DD} Pin	I_{DD}	V_{DD} = 0.9V to 1.5V			1.5	mA
Input Current: I_{DD} Plus Inductor Current	I_{IN}	V_{DD} = 1.5V, See Figure 1, Table 1		26	32	mA
$V_{A\text{-}B}$ Output Drive Frequency	f_{EL}	V_{DD} = 1.5V, See Figure 1, Table 1		500		Hz
Boost Converter Switching Frequency	f_{SW}	V_{DD} = 1.5V, See Figure 1, Table 1		26		kHz
Switching Duty Cycle	D_{SW}	V_{DD} = 1.5V, See Figure 1		87.5		%
Disable Input LOW Voltage (Disable pin available on die only)	V_{DISL}		GND		0.2	V
Disable Input HIGH Voltage (Disable pin available on die only)	V_{DISH}		V_{DD}-0.5V		V_{DD}	V

Typical Characteristics

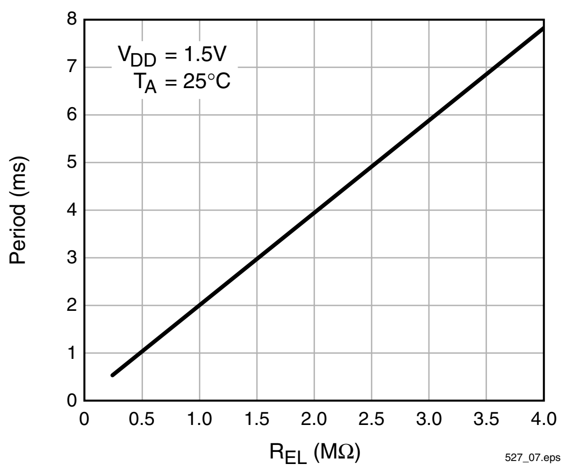
EL Lamp Drive Frequency



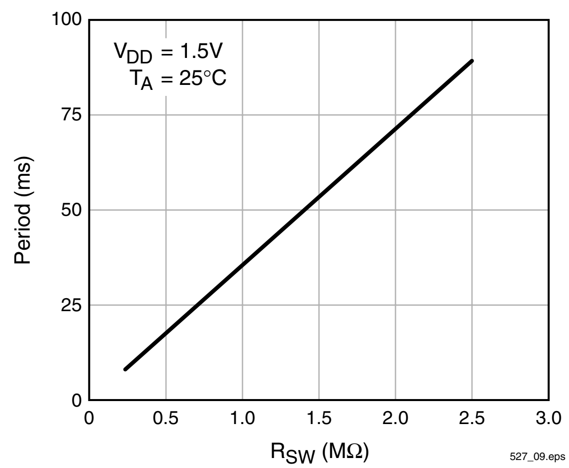
Boost Converter Switching Frequency



EL Lamp Drive Period



Boost Converter Switching Period



Pin Descriptions

Pin Number	Name	Function
1	V_{DD}	Positive voltage supply for the IMP527. Inductor L may be connected here or to a separate supply.
2	$R_{SW\text{-}OSC}$	Switch-mode resistor pin. Switching frequency is determined by external resistor R_{SW}, connected between pin 2 and V_{DD}.
3	C_S	Boost converter storage capacitor. The voltage across the EL lamp is equal to twice the voltage at C_S.
4	L_X	Connection to flyback inductance, L.
5	GND	Ground pin.
6	V_B	EL lamp drive. The lamp is connected to a high-voltage bridge circuit with V_B providing the complementary connection to V_A.
7	V_A	EL lamp drive. (See above)
8	$R_{EL\text{-}OSC}$	The EL lamp oscillator frequency-setting pin. The frequency is controlled by resistor R_{EL}, connected from pin 8 to V_{DD}.
Disable Pad	DIS	Available only in die form. Setting DIS HIGH disables the chip.

External Components

External Component	Description and Selection Guide
Diode	A fast reverse recovery diode, with BV > 100, such as a 1N4148.
Capacitor C_S	The high voltage capacitor that stores the inductive energy transferred through the catch diode. A 100 volt capacitor between 10nF and 100nF is recommended.
Resistor R_{EL}	The EL lamp oscillator frequency-setting resistor. R_{EL} is connected between pin 8 and V_{DD}, providing a frequency inversely proportional to R_{EL}; as R_{EL} increases, the EL lamp frequency decreases along with the current drawn by the lamp. Lamp color is also determined by this frequency. A 1MΩ resistor between the $R_{EL\text{-}OSC}$ pin and the V_{DD} supply results in a lamp frequency around 500Hz.
Resistor R_{SW}	Switching Oscillator frequency-setting resistor. R_{SW} is connected between the $R_{SW\text{-}OSC}$ pin and the V_{DD} supply. The switching frequency is inversely proportional to the resistor value, dropping as the resistance increases.
Capacitor C_{SW}	This is an optional noise-suppression capacitor connected from ground to the $R_{SW\text{-}OSC}$ pin. A 100pF capacitor is recommended.
Inductor L	The inductor provides the voltage boost needed by means of inductive “flyback”. The internal MOSFET switch alternately opens and closes the ground connection for the inductor at the L_X pin. When the switch opens, the inductor potential will forward-bias the diode and the current will pass through to the storage capacitor C_S, charging it to a high voltage. As the value of the inductor is increased, the switching frequency set by R_{SW} should also be increased to prevent saturation. In general, smaller value inductors that can handle more current are more desirable when larger-area EL lamps must be driven. A small electrolytic capacitor (10µF, 16V), normally present across the inductor supply V_{IN}, will likely eliminate the need for C_{SW}.

Test Circuit

Figure 1 shows the IMP527 configured to drive an EL lamp, represented as a 3nF capacitor.

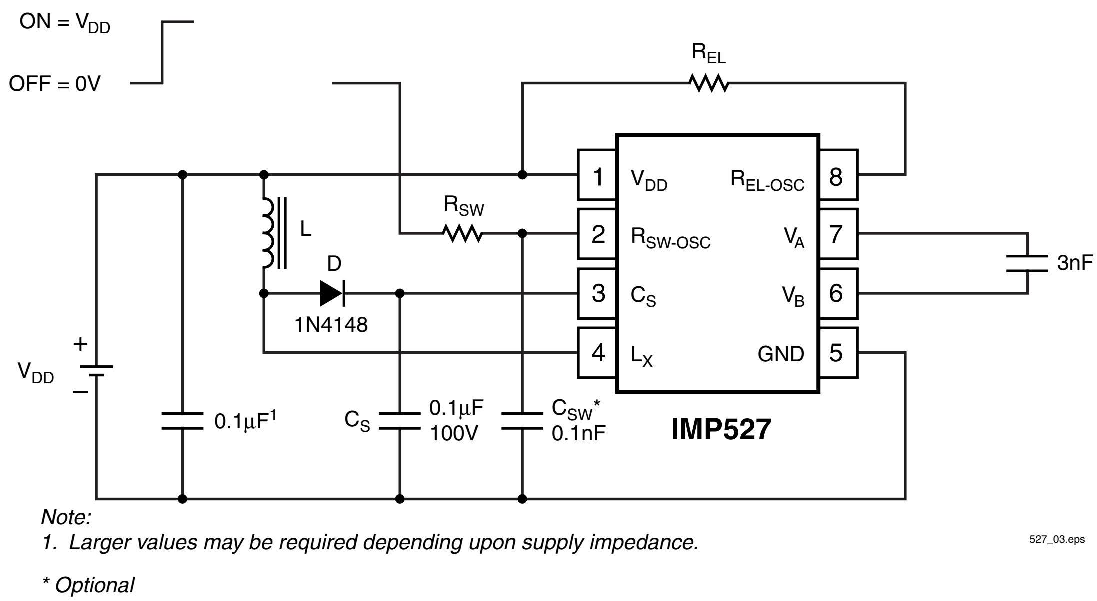


Figure 1. Test Circuit

Table 1. V_{IN} = 1.5V

Component	Connections	Value	Description
R_{SW}	V_{DD}, R_{SW-OSC}	1MΩ	Boost converter oscillator bias resistor
R_{EL}	V_{DD}, R_{EL-OSC}	1MΩ	EL lamp driver oscillator bias resistor
L	V_{DD}, L_X[2]	330µH[2]	Boost converter inductor
C_S	C_S, GND	0.1µF/100V	Boost converter storage capacitor
D	L_X, C_S	1N4148	Switching diode
C_{SW}	R_{SW-OSC}, GND	0.1nF	Noise-suppression capacitor (optional)

Notes. 2. Murata LQH4N331K04 (8.2Ω max. DCR)

Table 2. V_{IN} = 0.9V

Component	Connections	Value	Description
R_{SW}	V_{DD}, R_{SW-OSC}	1MΩ	Boost converter oscillator bias resistor
R_{EL}	V_{DD}, R_{EL-OSC}	2.62MΩ	EL lamp driver oscillator bias resistor
L	V_{DD}, L_X[3]	680µH[3]	Boost converter inductor
C_S	C_S, GND	0.1µF/100V	Boost converter storage capacitor
D	L_X, C_S	1N4148	Switching diode
C_{SW}	R_{SW-OSC}, GND	0.1nF	Noise-suppression capacitor (optional)

Notes. 3. Coilcraft DS1608C-684 (2.2Ω max. DCR)

Enable/Disable Operation

Figure 2 shows how the IMP527 can be enabled via a logic gate that connects R_{SW} to V_{DD}, and disabled by connecting it to ground.

The IMP527 can also be disabled using a pad on the die. The Disable function pin is not available in packaged parts.

Enable/Disable Table	
R_{SW} Connection	IMP527 State
V_{DD}	Enabled
Ground	Disabled

Disable PAD Connection (Available only with dice)	IMP527 State
HIGH (V_{DD})	Disabled
LOW (Ground)	Enabled

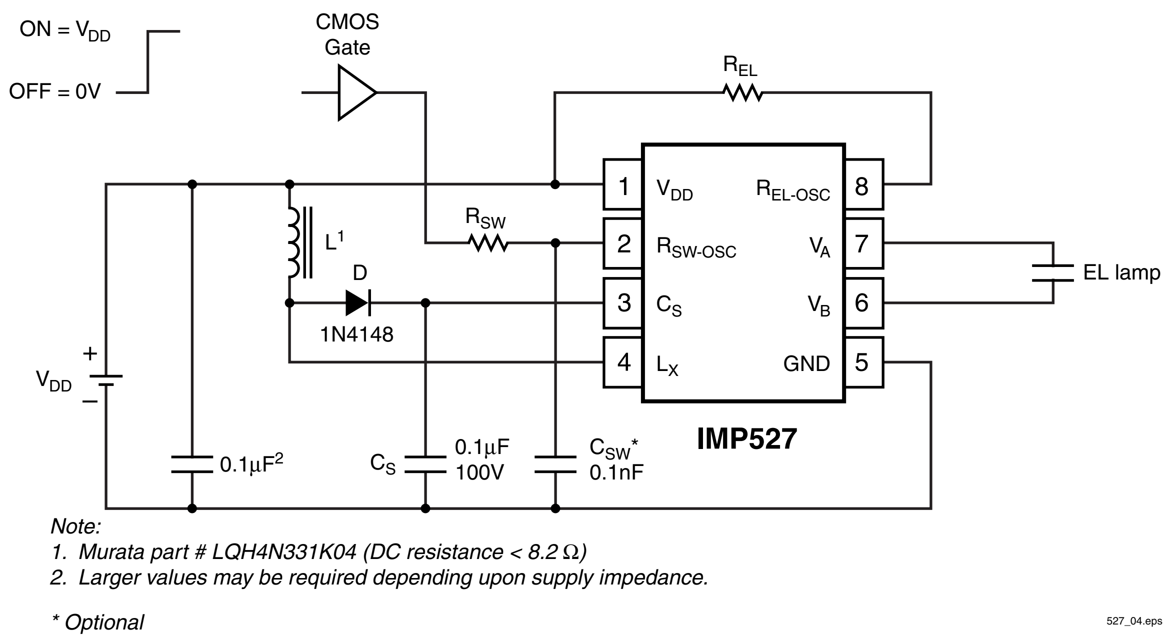


Figure 2. Enable/Disable Operation

High Voltages Present

The IMP527 generates high voltages and caution should be exercised.

Inductor Manufacturers

Manufacturer	Series	USA Phone Number
Toko	D52FU	(847) 297-0070
Coilcraft	DS1608, DO1608, DT1608	(847) 639-6400
River Electronics	FLC32	(310) 320-7488
Murata	LQH4N	(800) 831-9172

IMP528

POWER MANAGEMENT

High-Voltage EL Lamp Driver

– 220 V_{PP} Drive

The IMP528 is an Electroluminescent (EL) lamp driver with the four EL lamp driving functions on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. The IMP528 drives EL lamps of up to 50nF capacitance to high brightness; EL lamps with capacitances greater than 50nF can be driven, but will be lower in light output. The typical regulated output voltage that is applied to the EL lamp is 220V peak-to-peak. The circuit requires few external components; a single inductor, single diode, two capacitors and two resistors. Two of these resistors set the frequency for two internal oscillators.

Unlike other EL lamp drivers, the IMP528 does not require an external protection resistor in series with the EL lamp.

The IMP528 operates over a 2.0V to 6.5V supply voltage range. A regulated, low-power source can supply the low quiescent current of the IMP528. The inductor may be driven from an independent, unregulated supply voltage in dual supply applications.

An internal circuit shuts down the switching regulator when the lamp drive voltage reaches 220V peak-to-peak. This conserves power and extends battery life.

The IMP528 is available in MicroSO and SO-8 packages and in die or wafer form.

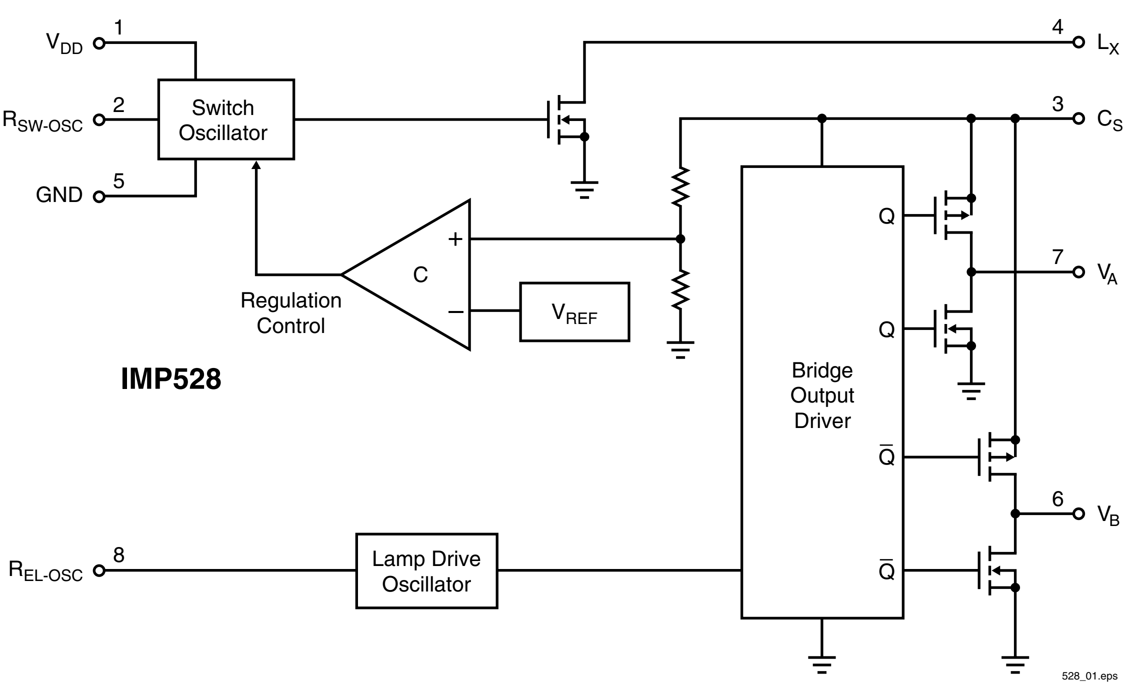
Key Features

- 220V peak-to-peak typical AC output voltage
- Low Power: 420µA typical V_{DD} current
- Wide operating voltage range-from 2.0V to 6.5V
- Large output load capability - drives lamps with more than 50nF capacitance
- Eliminates external protection resistor in series with EL lamp
- Adjustable output lamp frequency for control of lamp color, lamp life, and power consumption
- Adjustable converter frequency to minimize power consumption
- High-Voltage CMOS Process
- MicroSO package option

Applications

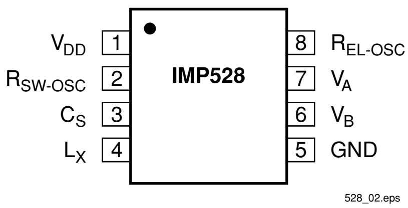
- GPS units/Pagers/Cellular phones
- PDAs/Handheld computers
- Safety illumination
- Portable instrumentation
- Battery-operated displays
- LCD modules
- Toys

Block Diagram



Pin Configuration

SO/ MicroSO



Pin Compatible With IMP803 and IMP560

Ordering Information

Part Number	Input Voltage	Regulated Output Voltage	Temperature Range	Pins-Package
IMP528ESA	2.0V to 6.5V	Yes	−40°C to +85°C	8-SO
IMP528EMA	2.0V to 6.5V	Yes	−40°C to +85°C	8-MicroSO
IMP528/D*	2.0V to 6.5V	Yes	25°C	Dice
IMP528/D1**	2.0V to 6.5V	Yes	25°C	Dice

** Disable pad not active*
*** Disable pad active*
Add /T to ordering part number for Tape and Reel.

Absolute Maximum Ratings

V_{DD} . . . . –0.5V to +7.0V
$V_{RSW\text{-}OSC}$ and $V_{REL\text{-}OSC}$ . . . . –0.5V to V_{DD} +0.3V
V_{CS}, L_X . . . . –0.5V to +120V
Operating Temperature Range . . . . –40°C to +85°C
Storage Temperature Range . . . . –65°C to +150°C
Power Dissipation (SO) 400mW
Power Dissipation (MicroSO) 300mW
V_A, V_B . . . . –0.5V to V_{CS} (pin 3)

Note: All voltages are referenced to GND.

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

Electrical Characteristics

Unless otherwise noted, V_{DD} = 3.0V, R_{SW} = 910kΩ, R_{EL} = 2.7MΩ, and T_A = 25°C.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
ON-resistance of MOS Switch	$R_{DS(ON)}$	I = 100mA		3.0	8	Ω
Output Voltage Regulation	V_{CS}	V_{DD} = 2.0 to 6.5V		110		V
Output Voltage Peak-to-peak (in regulation)	V_A-V_B	V_{DD} = 2.0 to 6.5V		220		V
Input Current at V_{DD} Pin	I_{DD}	V_{DD} = 3.0V, See Figure 1		420	700	µA
Input Current at V_{DD} Pin	I_{DD}	V_{DD} = 5.0V		500	750	µA
Quiescent V_{DD} Supply Current, Disabled	I_{DDQ}	$V_{RSW\text{-}OSC}$ < 100mV		20	200	nA
Input Current: I_{DD} Plus Inductor Current	I_{IN}	V_{DD} = 3.0V, See Figure 1		21	31	mA
$V_{A\text{-}B}$ Output Drive Frequency	f_{EL}	V_{DD} = 3.0V, See Figure 1		250		Hz
Switching Frequency	f_{SW}	V_{DD} = 3.0V, See Figure 1		61		kHz
Switching Duty Cycle	D_{SW}	V_{DD} = 3.0V, See Figure 1		88		%

Pin Descriptions

Pin Number	Name	Function
1	V_{DD}	Positive voltage supply for the IMP528. Inductor L may be connected here or to a separate unregulated supply.
2	$R_{SW\text{-}OSC}$	Switch-mode resistor pin. Switching frequency is determined by an external resistor, R_{SW}.
3	C_S	Boost converter storage capacitor. The voltage across the EL lamp is equal to twice the voltage at C_S.
4	L_X	Connection to flyback inductance, L.
5	GND	Ground pin.
6	V_B	EL lamp drive. The lamp is connected in a high-voltage bridge circuit with V_B providing the complementary connection to V_A. The peak-to-peak AC voltage across the EL lamp is thus two times V_{CS}.
7	V_A	EL lamp drive. (See above)
8	$R_{EL\text{-}OSC}$	The EL lamp oscillator frequency setting pin. The oscillator frequency is controlled by external resistor R_{EL}.

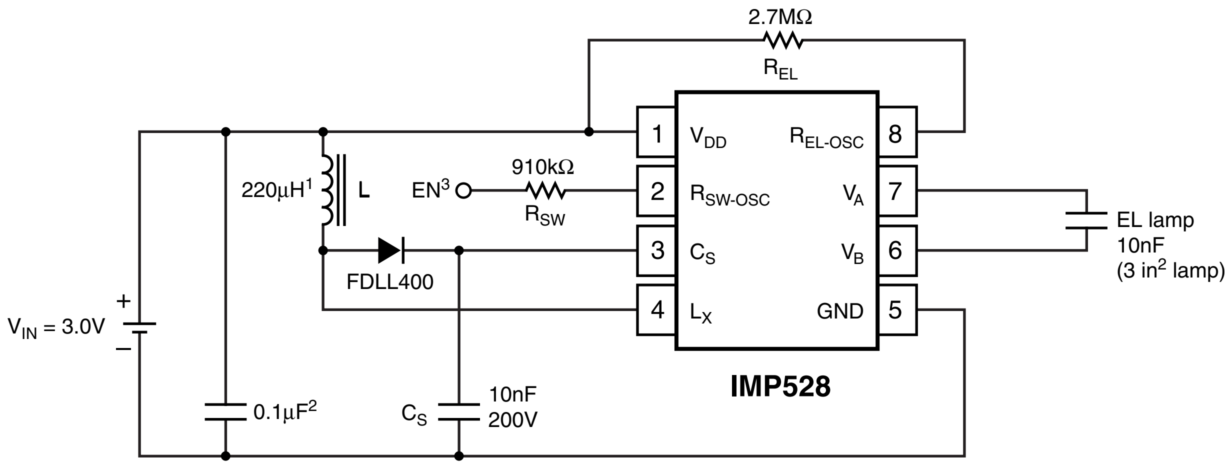
External Components

External Component	Description and Selection Guide
Diode	Catch diode. A fast reverse recovery diode, with BV > 150V, such as an FDLL400 (150V).
Capacitor C_S	This is the high voltage capacitor that stores the inductive energy transferred through the catch diode. A capacitor with WV > 120V between 10nF and 100nF is recommended.
Resistor R_{EL}	The EL lamp oscillator frequency setting resistor. This resistor, connected between the $R_{EL\text{-}OSC}$ pin and V_{DD}, provides an oscillator frequency inversely proportional to R_{EL}; as R_{EL} increases, the EL lamp frequency decreases along with the current drawn by the lamp. Lamp color is also determined by this frequency. A 2.7MΩ resistor between the $R_{EL\text{-}OSC}$ pin and the V_{DD} supply results in a lamp frequency around 250Hz.
Resistor R_{SW}	Switching Oscillator frequency setting resistor. The switching oscillator resistor is connected between the $R_{SW\text{-}OSC}$ pin and the V_{DD} supply. The switching frequency is inversely proportional to the resistor value, dropping as the resistance increases.
Inductor L	The inductor provides the voltage boost needed by means of inductive “flyback”. The internal MOSFET switch alternately opens and closes the ground connection for the inductor at the L_X pin. When this internal switch opens, the inductor potential will forward-bias the catch diode and the current will pass through the storage capacitor C_S, charging it to a high voltage. Smaller inductors are preferred to prevent saturation. As the value of the inductor increases (and the series DC resistance of the inductor decreases), the switching frequency set by R_{SW} should be increased to prevent saturation. In general, smaller value inductors that can handle more current are more desirable when larger area EL lamps must be driven.

Application Information

Test and Application Circuit, 3.0V

Figure 1 shows the IMP528 configured to drive an EL lamp with a 3.0V input.



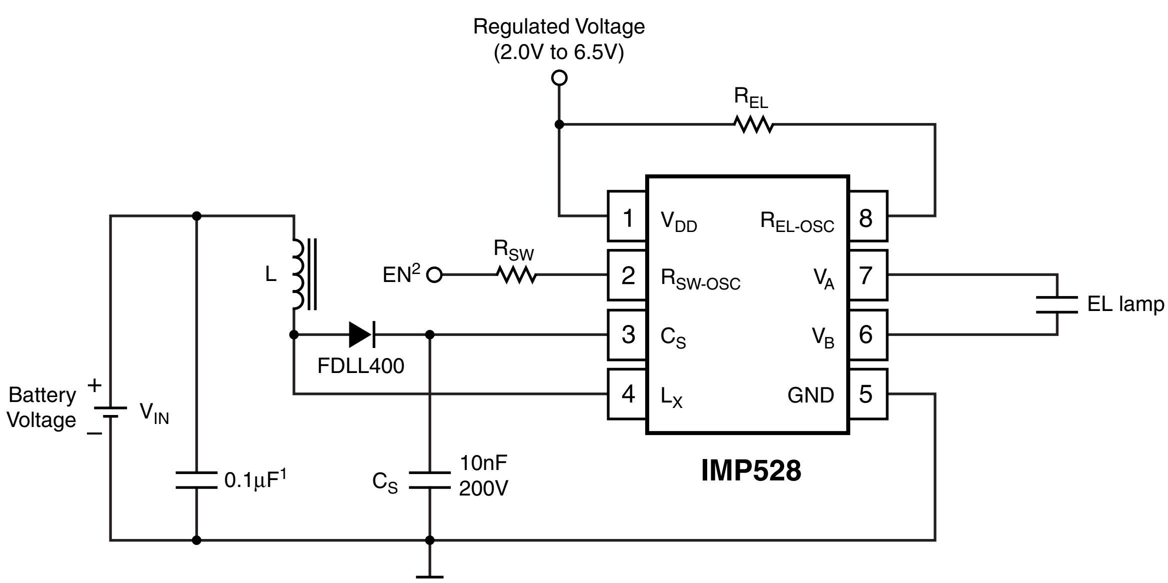
Note:
1. *Murata part # LQH4N221K04 (DC resistance <5Ω)*
2. *Larger values may be required depending upon supply impedance.*
3. *EN is connected to V_{DD} to enable and to GND to disable.*

528_03.eps

Figure 1. 3.0V Application

Dual Supply Operation with 1.5V Battery

The IMP528 can also be operate from a single battery cell when a regulated voltage higher than 2.0V is also available. This dual supply configuration, shown in *Figure 2*, uses the regulated voltage to operate the IMP528 while the energy for the high-voltage boost circuit comes from the battery.



1. *Larger values may be required depending upon supply impedance.*
2. *EN is connected to V_{DD} to enable and to GND to disable.*

528_04.eps

Figure 2. Dual Supply Operation

High–Voltages Present

Switch Resistance

The IMP528 inductor switch resistance is typically below 3.5Ω, as shown in *Figure 3*.

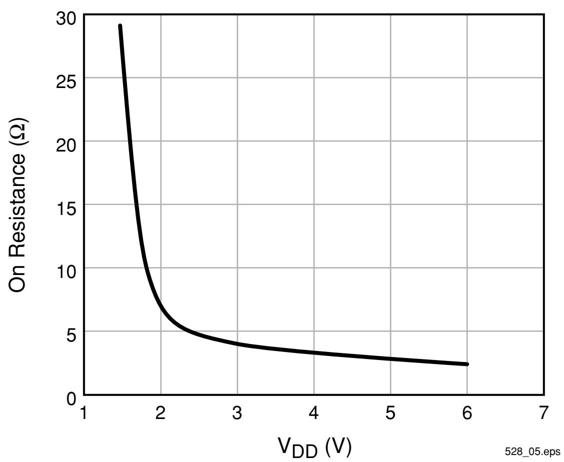


Figure 3. Boost Switch ON-Resistance

The IMP528 generates high voltages and caution should be exercised.

Notes

Project

Power Efficient EL Lamp Driver

The IMP560 is an Electroluminescent (EL) lamp driver designed for systems with low EL lamp drive voltage requirements. It is ideal for low ambient light applications or where small lamps are used. With just one-half the inductor current of the IMP803, the IMP560 reduces system power consumption and extends battery life. Input supply voltage range is 2.0V to 6.5V and quiescent current is a low 420µA. Typical EL lamp drive voltage is ±56V.

All four EL lamp-driving functions are on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. EL lamps of up to 6nF capacitance can be driven to high brightness.

The circuit requires few external components; a single inductor, a single diode, two capacitors and three resistors. Two of these resistors set the frequencies for two internal oscillators. An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 120V peak-to-peak. This conserves power and extends battery life.

A disable mode puts the chip into a low current drain mode. With a 3.0V supply, quiescent current drops to 200nA maximum, 50nA typical. The chip is disabled by connecting the oscillator frequency setting resistor R_{SW} to ground.

The IMP560 is available in MicroSO and SO-8 packages and in die or wafer form.

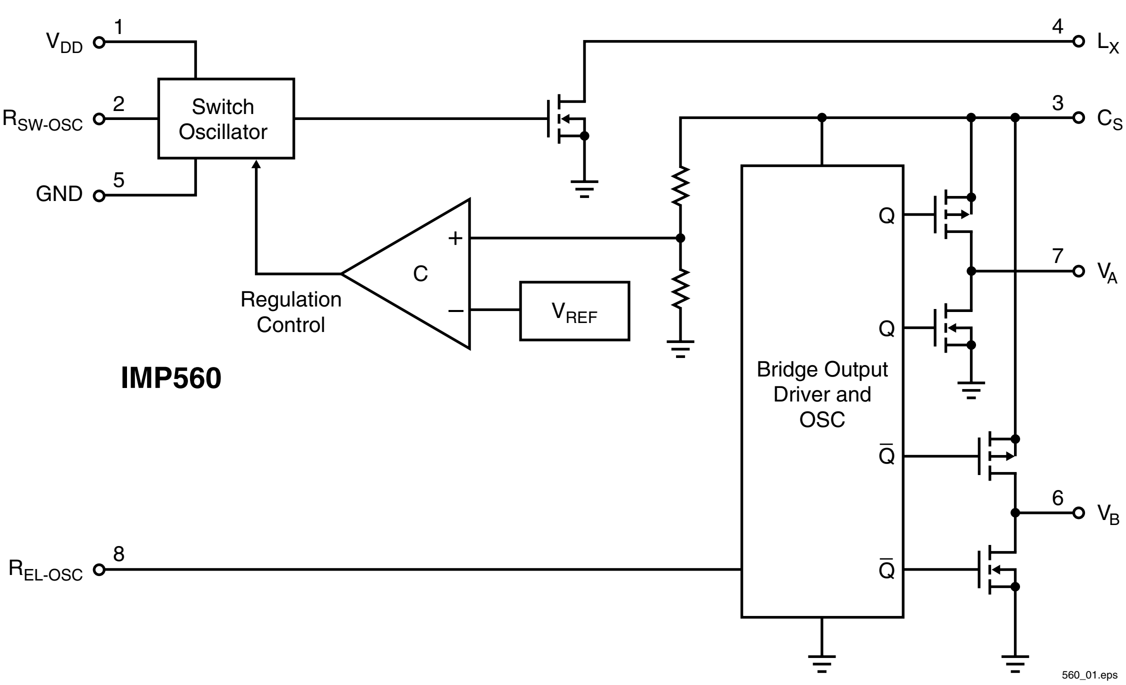
Key Features

- 112V peak-to-peak typical AC output voltage
- Low input current (w/inductor current)......12mA
- Low disabled input current......50nA
- Wide operating voltage range - from 2.0V to 6.5V
- Simple design requires few passive components
- Adjustable output lamp frequency controls lamp color and power consumption
- Adjustable converter frequency for minimum power consumption
- IMP803 pin-compatible
- MicroSO package option

Applications

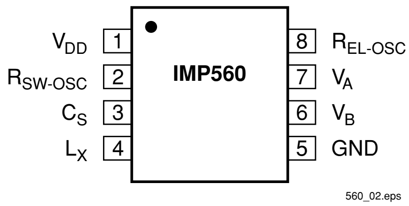
- Night lights
- Automotive displays
- Cellular phones
- Pagers
- Clocks and radios
- Portable GPS receivers
- LCD module backlights

Block Diagram



Pin Configuration

SO/MicroSO



Pin Compatible With IMP803

Ordering Information

Part Number	Input Voltage	Regulated Output Voltage	Temperature Range	Pins-Package
IMP560EMA	2.0V to 6.5V	YES	−40°C to +85°C	8-MicroSO
IMP560ESA	2.0V to 6.5V	YES	−40°C to +85°C	8-SO
IMP560/D*	2.0V to 6.5V	YES	25°C	Dice
IMP560/D1**	2.0V to 6.5V	YES	25°C	Dice

** Disable pad not active*
*** Disable pad active*

Absolute Maximum Ratings

Supply Voltage, V_{DD}, $V_{RSW\text{-}OSC}$ and $V_{REL\text{-}OSC}$ . . . −0.5V to +7.0V
Output Voltage, V_{CS} . . . . −0.5V to +120V
Operating Temperature Range . . . . −40°C to +85°C
Storage Temperature Range. . . . . −65°C to +150°C
Power Dissipation (SO) 400mW
Power Dissipation (MicroSO) 300mW

Note: All voltages are referenced to GND.

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

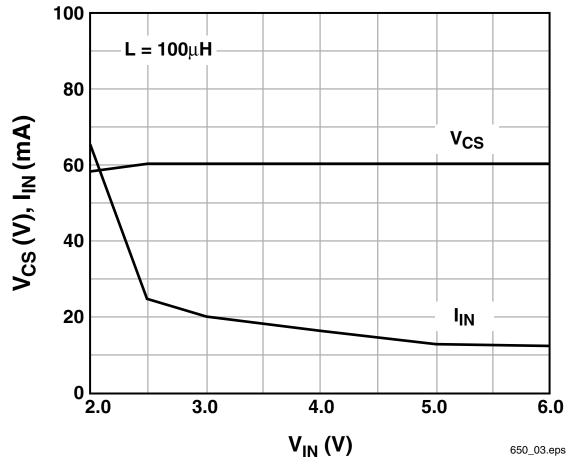
Electrical Characteristics

Unless otherwise noted, V_{DD} = 3.0V, R_{SW} = 750kΩ, R_{EL} = 2.0MΩ, and T_A = 25°C.

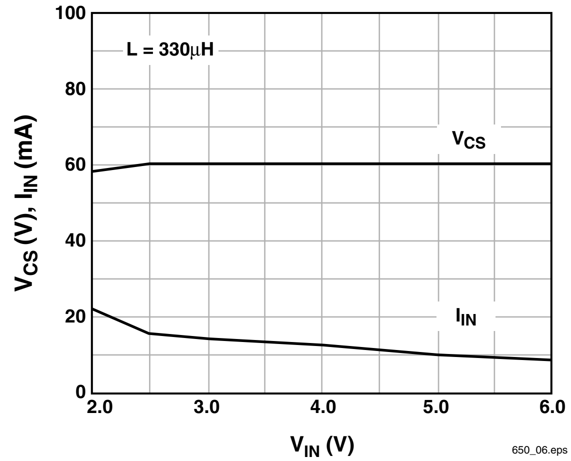
Parameter	Symbol	Conditions	Min	Typ	Max	Units
ON-resistance of MOS Switch	$R_{DS(ON)}$	I = 100mA		3.5	8	Ω
Output Voltage Regulation	V_{CS}	V_{DD} = 2.0 to 6.5V	52	56	65	V
Output Voltage Peak-to-peak (in regulation)	V_A-V_B	V_{DD} = 2.0 to 6.5V	104	112	120	V
Quiescent V_{DD} Supply Current, Disabled	I_{DDIS}	$V_{RSW\text{-}OSC}$ < 100mV		50	200	nA
Input Current at V_{DD} Pin	I_{DD}	V_{DD} = 3.0V, See Figure 1		470	700	µA
Input Current at V_{DD} Pin	I_{DD}	V_{DD} = 5.0V, See Figure 2		500	750	µA
Input Current: I_{DD} Plus Inductor Current	I_{IN}	V_{DD} = 3.0V, See Figure 1		12		mA
$V_{A\text{-}B}$ Output Drive Frequency	f_{EL}	V_{DD} = 3.0V, See Figure 1	300	370	430	Hz
Switching Frequency	f_{SW}	V_{DD} = 3.0V, See Figure 1	50	70	90	kHz
Switching Duty Cycle	D_{SW}	V_{DD} = 3.0V, See Figure 1		88		%

Typical Characteristics

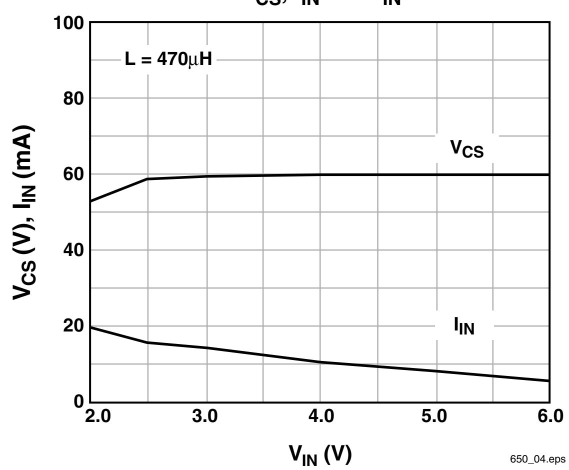
V_{CS}, I_{IN} vs. V_{IN}



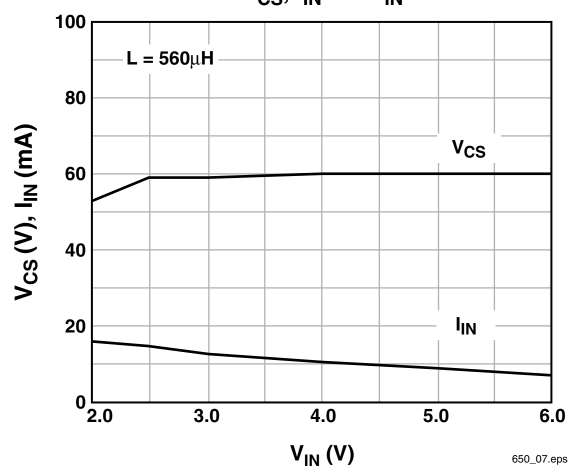
V_{CS}, I_{IN} vs. V_{IN}



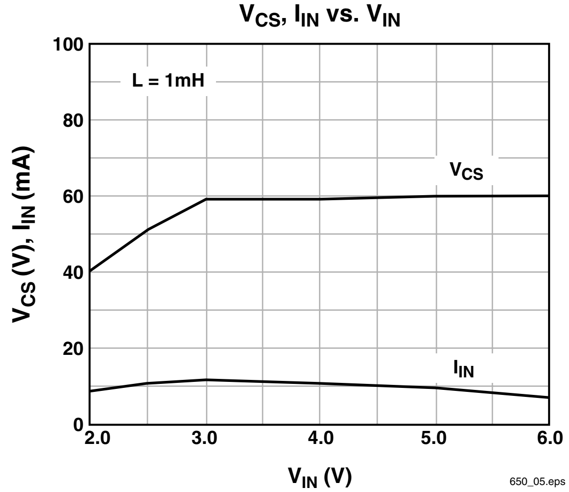
V_{CS}, I_{IN} vs. V_{IN}



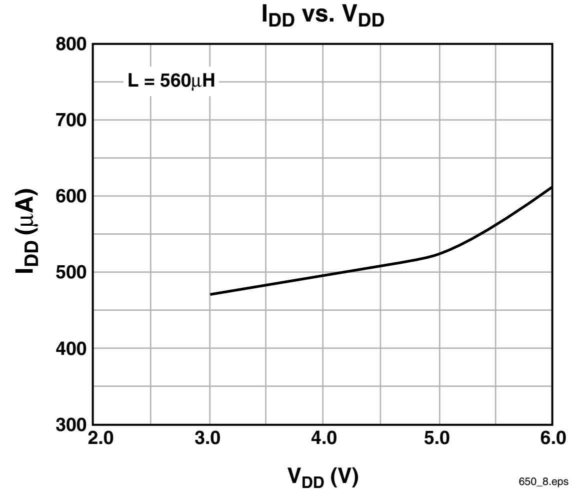
V_{CS}, I_{IN} vs. V_{IN}



V_{CS}, I_{IN} vs. V_{IN}



I_{DD} vs. V_{DD}



Pin Descriptions

Pin Number	Name	Function
1	V_{DD}	Positive voltage supply for the IMP560. Inductor L may be connected here or to a separate unregulated supply.
2	$R_{SW\text{-}OSC}$	Switch-mode resistor pin. Switching frequency is determined by an external resistor, R_{SW}.
3	C_S	Boost converter storage capacitor. The voltage across the EL lamp is equal to twice the voltage at C_S.
4	L_X	Connection to flyback inductance, L.
5	GND	Ground pin.
6	V_B	EL lamp drive. The lamp is connected in a high-voltage bridge circuit with V_B providing the complementary connection to V_A. The peak-to-peak AC voltage across the EL lamp is thus two times V_{CS}.
7	V_A	EL lamp drive. (See above)
8	$R_{EL\text{-}OSC}$	The EL lamp oscillator frequency setting pin. The oscillator frequency is controlled by external resistor R_{EL}.

External Components

External Component	Description and Selection Guide
Diode	A fast reverse recovery diode, with BV > 100, such as a 1N4148.
Capacitor C_S	This is the high voltage capacitor that stores the inductive energy transferred through the diode. A 100 volt capacitor between 10nF and 100nF is recommended.
Resistor R_{EL}	The EL lamp oscillator frequency setting resistor. This resistor, connected between the $R_{EL\text{-}OSC}$ pin and ground, provides an oscillator frequency inversely proportional to R_{EL}; as R_{EL} increases, the EL lamp frequency decreases along with the current drawn by the lamp. Lamp color is also determined by this frequency. A 2MΩ resistor between the $R_{EL\text{-}OSC}$ pin and the V_{DD} supply results in a lamp frequency around 350Hz: a 1MΩ resistor will give ≈700Hz.
Resistor R_{SW}	Switching Oscillator frequency setting resistor. The switching oscillator resistor is connected between the $R_{SW\text{-}OSC}$ pin and the V_{DD} supply. The switching frequency is inversely proportional to the resistor value, dropping as the resistance increases.
Inductor L	The inductor provides the voltage boost needed by means of inductive “flyback”. The internal MOSFET switch alternately opens and closes the ground connection for the inductor at the L_X pin. When this internal switch opens, the inductor potential will forward-bias the diode and the current will pass through the storage capacitor C_S, charging it to a high voltage. Smaller inductors are preferred to prevent saturation. As the value of the inductor increases (and the series DC resistance of the inductor decreases), the switching frequency set by R_{SW} should be increased to prevent saturation. In general, smaller value inductors that can handle more current are more desirable when larger area EL lamps must be driven.

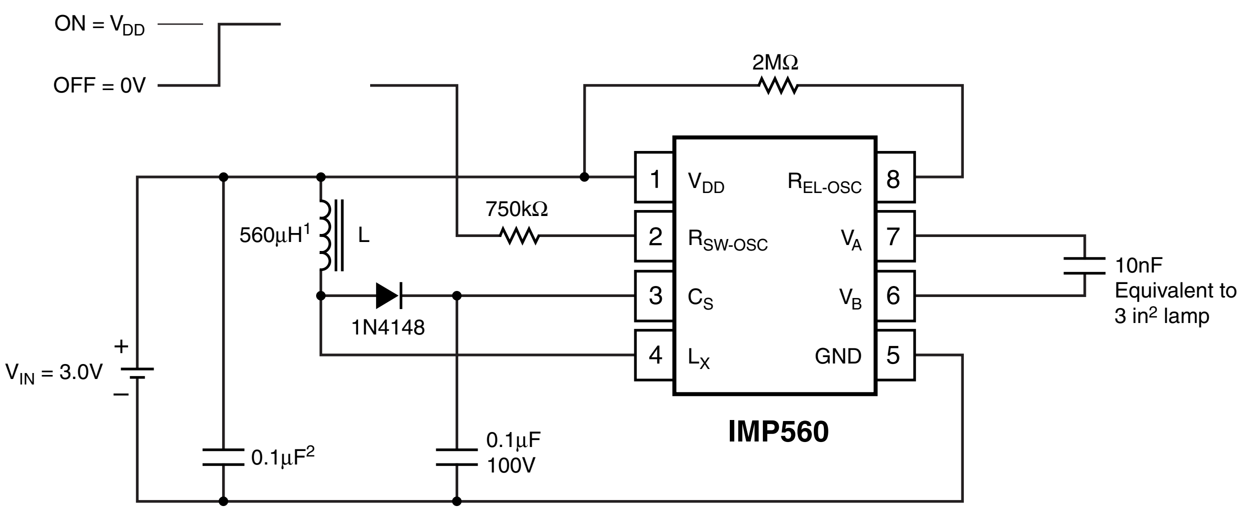
High–Voltages Present

The IMP560 generates high voltages and caution should be exercised.

Application Information

Test and Application Circuit, 3.0V

Figure 1 shows the IMP560 configured to drive a 3-square-inch EL lamp, represented as a 10nF capacitor.



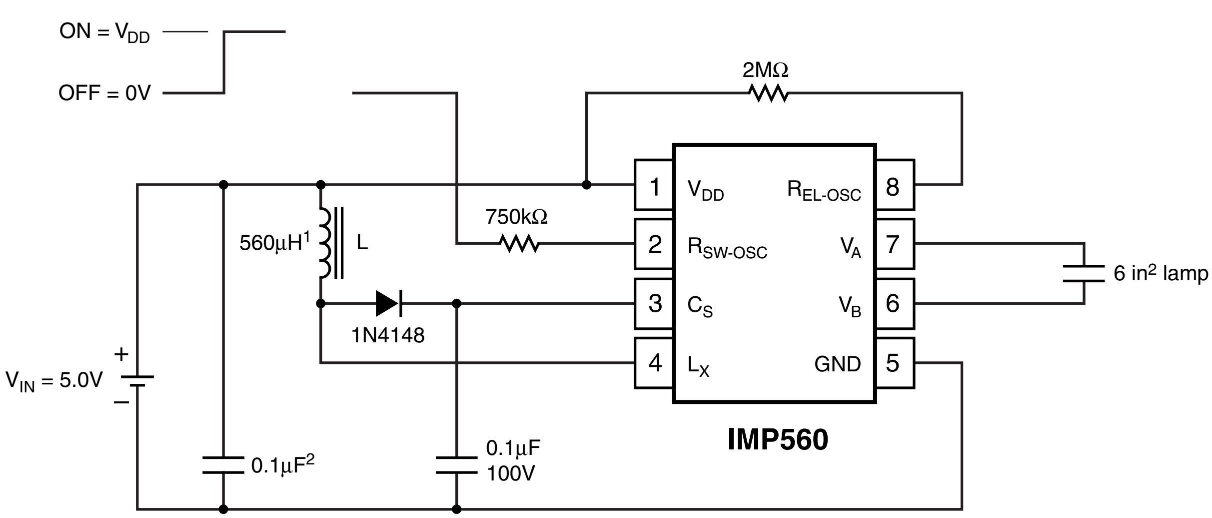
Note:
1. *Murata part # LQH4N561K04 (DC resistance <14.5Ω)*
2. *Larger values may be required depending upon supply impedance.*

560_09.eps

Figure 1. 3.0V Application

Test and Application Circuit, 5.0V

Figure 2 shows a 5.0V input application driving a 6-square-inch EL lamp.



Note:
1. *Murata part # LQH4N561K04 (DC resistance <14.5Ω)*
2. *Larger values may be required depending upon supply impedance.*

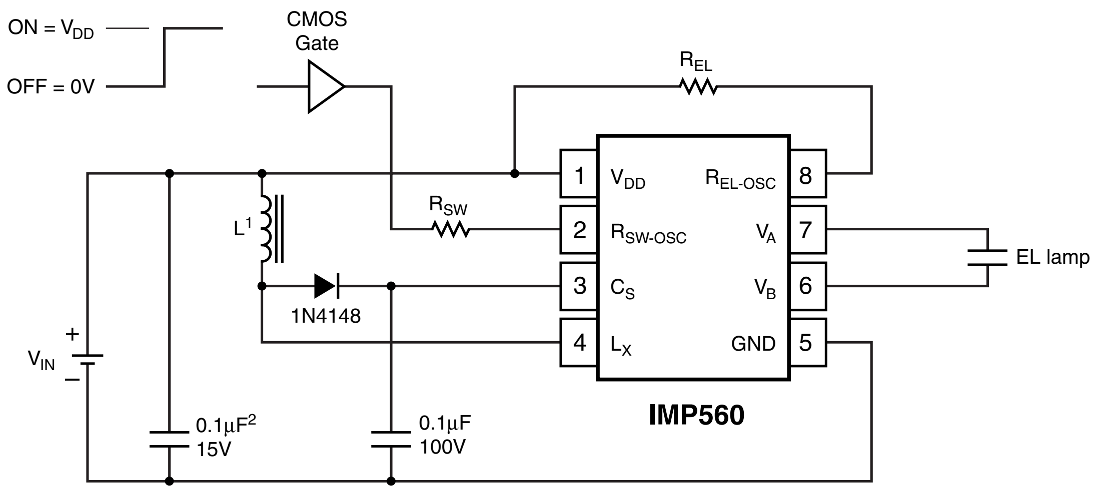
560_10.eps

Figure 2. 5.0V Application

Enable/Disable Operation

Figure 3 shows the IMP560 can be enabled via a logic gate that connects R_{SW} to V_{DD}, and disabled by connecting it to ground. R_{EL} may be connected either to V_{DD} or to the gate.

Enable/Disable Table	
R_{SW} Connection	**IMP560 State**
V_{DD}	Enabled
Ground	Disabled



Note:
1. Murata part # LQH4N561K04 (DC resistance <14.5Ω)
2. Larger values may be required depending upon supply impedance.

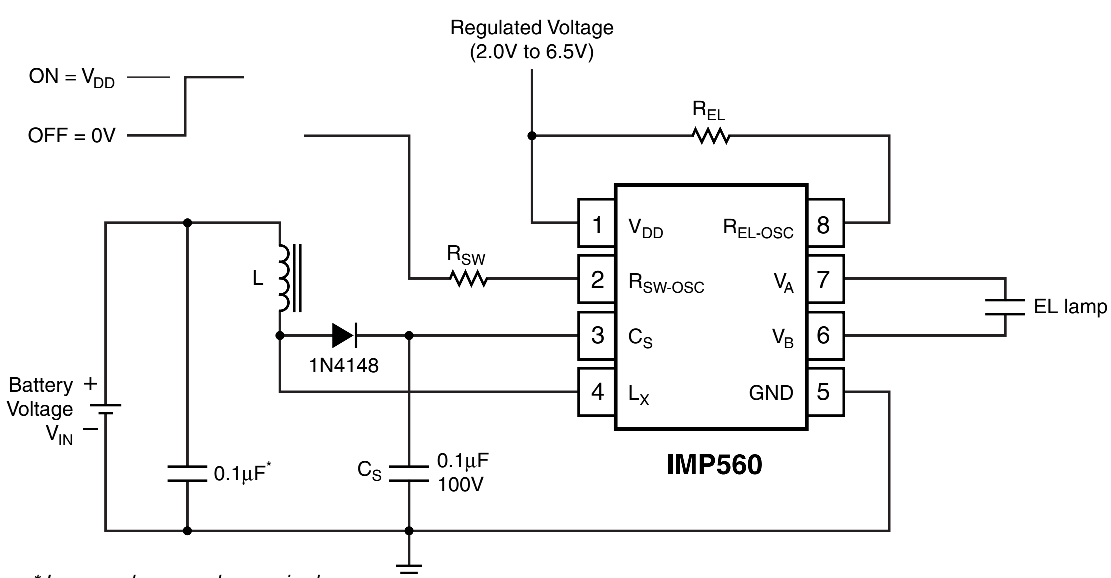
560_11.eps

Figure 3. Enable/Disable Operation

Dual Supply Operation with 1.5V Battery

The IMP560 can also be operate from a single battery cell when a regulated voltage higher than 2.0V is also available. The dual supply configuration, shown in *Figure 4*, uses the regulated voltage to operate the IMP560 while the energy for the high-voltage boost circuit comes from the battery. The current to run the internal logic is typically 420µA.

The circuit of *Figure 4* can also be used with batteries that exceed 6.0V as long as V_{DD} does not exceed 6.5V.



* Larger values may be required depending upon supply impedance

560_12.eps

Figure 4. Dual Supply Operation with High Battery Voltages

IMP803

ISO 9001 Registered

POWER MANAGEMENT

High-Voltage EL Lamp Driver

The IMP803 is an Electroluminescent (EL) lamp driver with the four EL lamp driving functions on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. The IMP803 drives EL lamps of up to 30nF capacitance to high brightness; EL lamps with capacitances greater than 30nF can be driven, but will be lower in light output. The typical regulated output voltage that is applied to the EL lamp is 180V peak-to-peak. The circuit requires few external components, a single inductor, single diode, two capacitors and three resistors. Two of these resistors set the frequency for two internal oscillators.

The IMP803 operates over a 2.0V to 6.5V supply voltage range. A regulated, low-power source can supply the low quiescent current of the IMP803. The inductor may be driven from an independent, unregulated supply voltage in dual supply applications.

An internal circuit shuts down the switching regulator when the lamp drive voltage reaches 180V peak-to-peak. This conserves power and extends battery life.

The IMP803 is available in MicroSO and SO-8 packages and in die or wafer form.

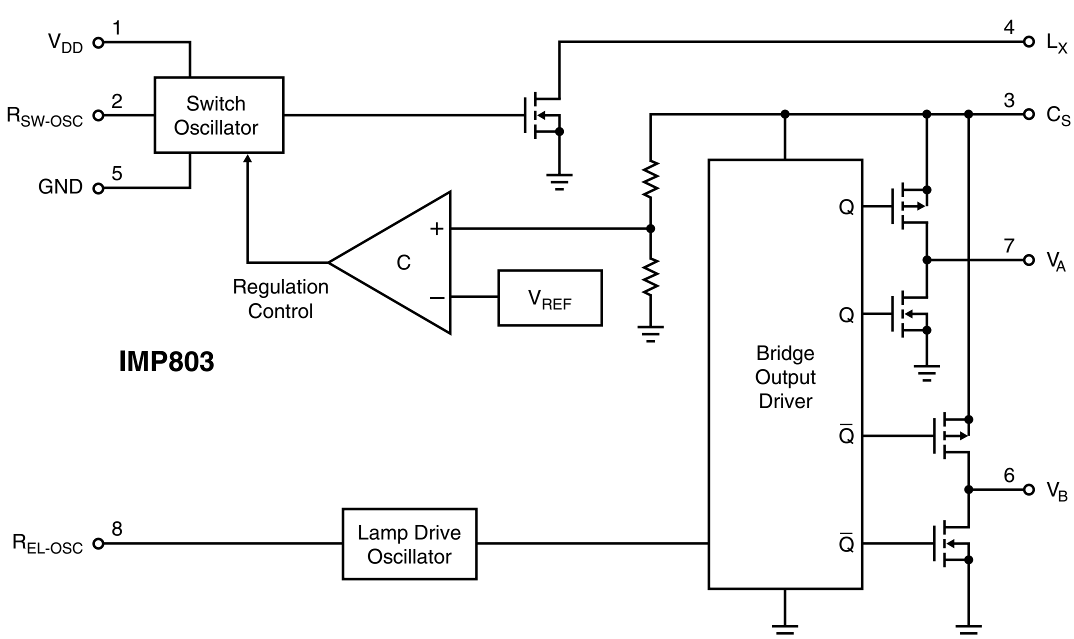
Key Features

- Low Power: 420μA typical V_{DD} current
- Wide operating voltage range - from 2.0V to 6.5V
- 180V peak-to-peak typical AC output voltage
- Large output load capability - drive lamps with more than 30nF capacitance
- Adjustable output lamp frequency for control of lamp color, lamp life, and power consumption
- Adjustable converter frequency to minimize power consumption
- Device can be Enabled/Disabled
- Low quiescent current – 20nA (disabled)
- High-Voltage CMOS Process
- MicroSO package option

Applications

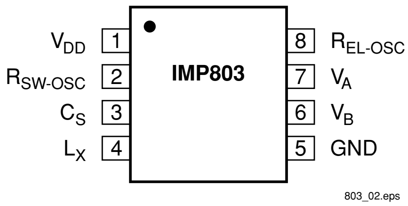
- GPS units/Pagers/Cellular phones
- PDAs/Handheld computers
- Safety illumination
- Portable instrumentation
- Battery-operated displays
- LCD modules
- Toys

Block Diagram



Pin Configuration

SO/ MicroSO



Pin Compatible With HV803 and IMP560

Ordering Information

Part Number	Input Voltage	Regulated Output Voltage	Temperature Range	Pins-Package
IMP803LG	2.0V to 6.5V	Yes	−40°C to +85°C	8-SO
IMP803IMA	2.0V to 6.5V	Yes	−40°C to +85°C	8-MicroSO
IMP803SX*	2.0V to 6.5V	Yes	25°C	Dice
IMP803/D1**	2.0V to 6.5V	Yes	25°C	Dice

** Disable pad not active*
*** Disable pad active*
Add /T to ordering part number for Tape and Reel.

Absolute Maximum Ratings

V_{DD}, $V_{RSW-OSC}$ and $V_{REL-OSC}$ . . . . –0.5V to +7.0V
V_{CS}, L_X . . . . –0.5V to +120V
Operating Temperature Range . . . . –40°C to +85°C
Storage Temperature Range . . . . –65°C to +150°C
Power Dissipation (SO) 400mW
Power Dissipation (MicroSO) 300mW
V_A, V_B . . . . –0.5V to V_{CS} (pin 3)

Note: All voltages are referenced to GND.

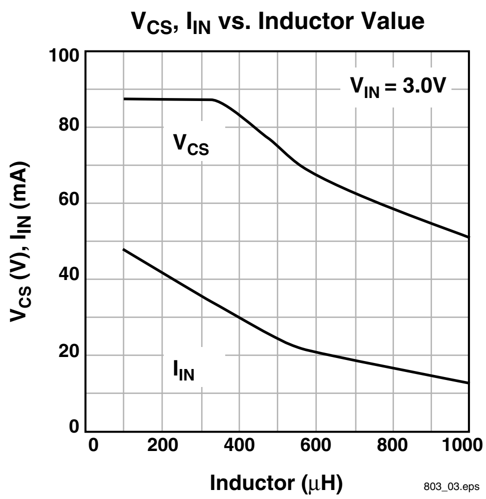
These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

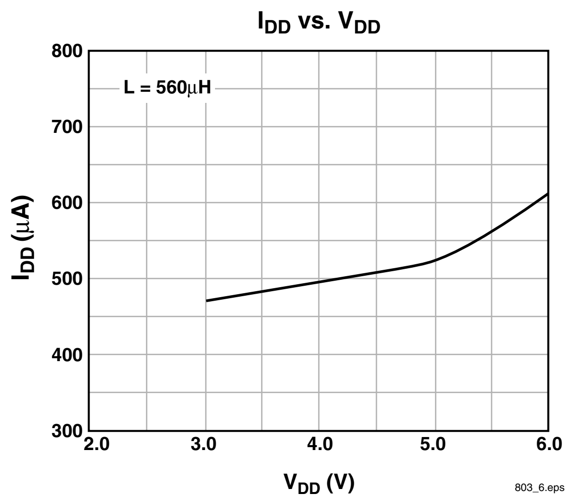
Electrical Characteristics

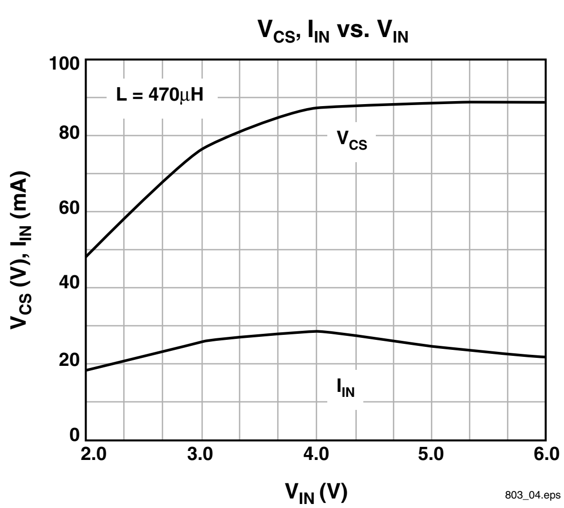
Unless otherwise noted, V_{DD} = 3.0V, R_{SW} = 750kΩ, R_{EL} = 2.0MΩ, and T_A = 25°C.

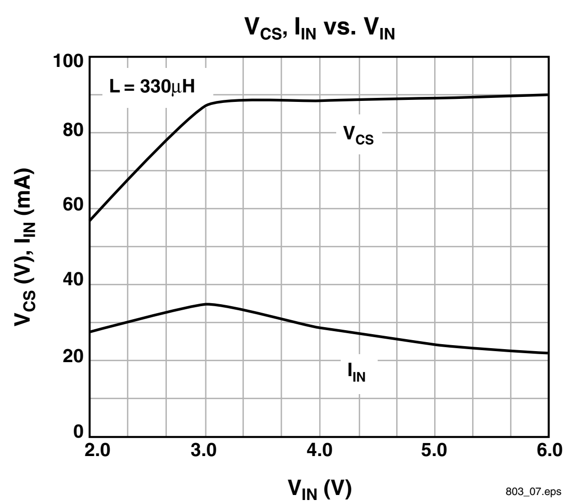
Parameter	Symbol	Conditions	Min	Typ	Max	Units
ON-resistance of MOS Switch	$R_{DS(ON)}$	I = 100mA		3.5	8	Ω
Output Voltage Regulation	V_{CS}	V_{DD} = 2.0 to 6.5V	80	90	100	V
Output Voltage Peak-to-peak (in regulation)	V_A-V_B	V_{DD} = 2.0 to 6.5V	160	180	200	V
Quiescent V_{DD} Supply Current, Disabled	I_{DDQ}	$V_{RSW-OSC}$ < 100mV		20	200	nA
Input Current at V_{DD} Pin	I_{DD}	V_{DD} = 3.0V, See Figure 1		420	700	µA
Input Current at V_{DD} Pin	I_{DD}	V_{DD} = 5.0V, See Figure 2		500	750	µA
Input Current: I_{DD} Plus Inductor Current	I_{IN}	V_{DD} = 3.0V, See Figure 1		20	31	mA
Output Voltage at V_{CS}	V_{CS}	V_{DD} = 3.0V, See Figure 1	60	74	100	V
V_{A-B} Output Drive Frequency	f_{EL}	V_{DD} = 3.0V, See Figure 1	300	370	430	Hz
Switching Frequency	f_{SW}	V_{DD} = 3.0V, See Figure 1	50	70	90	kHz
Switching Duty Cycle	D_{SW}	V_{DD} = 3.0V, See Figure 1		88		%

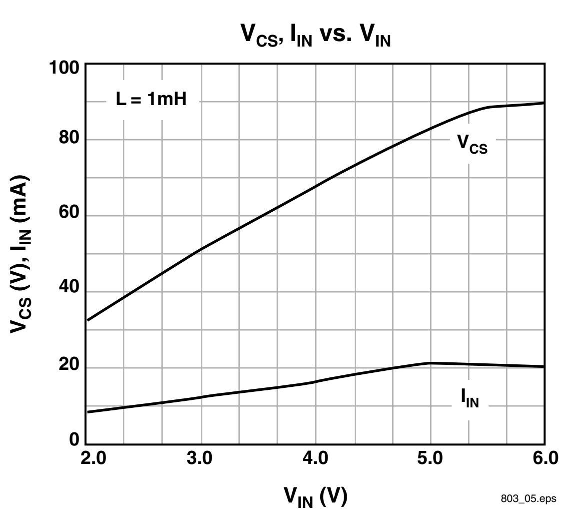
Typical Characteristics

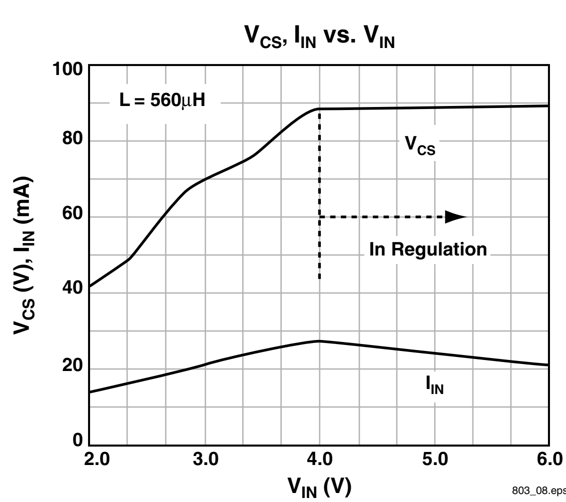












Pin Descriptions

Pin Number	Name	Function
1	V_{DD}	Positive voltage supply for the IMP803. Inductor L may be connected here or to a separate unregulated supply.
2	$R_{SW\text{-}OSC}$	Switch-mode resistor pin. Switching frequency is determined by an external resistor, R_{SW}.
3	C_S	Boost converter storage capacitor. The voltage across the EL lamp is equal to twice the voltage at C_S.
4	L_X	Connection to flyback inductance, L.
5	GND	Ground pin.
6	V_B	EL lamp drive. The lamp is connected in a high-voltage bridge circuit with V_B providing the complementary connection to V_A. The peak-to-peak AC voltage across the EL lamp is thus two times V_{CS}.
7	V_A	EL lamp drive. (See above)
8	$R_{EL\text{-}OSC}$	The EL lamp oscillator frequency setting pin. The oscillator frequency is controlled by external resistor R_{EL}.

External Components

External Component	Description and Selection Guide
Diode	Catch diode. A fast reverse recovery diode, with BV > 100, such as a 1N4148.
Capacitor C_S	This is the high voltage capacitor that stores the inductive energy transferred through the catch diode. A 100 volt capacitor between 10nF and 100nF is recommended.
Resistor R_{EL}	The EL lamp oscillator frequency setting resistor. This resistor, connected between the $R_{EL\text{-}OSC}$ pin and V_{DD}, provides an oscillator frequency inversely proportional to R_{EL}; as R_{EL} increases, the EL lamp frequency decreases along with the current drawn by the lamp. Lamp color is also determined by this frequency. A 2MΩ resistor between the $R_{EL\text{-}OSC}$ pin and the V_{DD} supply results in a lamp frequency around 350Hz: a 1MΩ resistor will give ≈700Hz.
Resistor R_{SW}	Switching Oscillator frequency setting resistor. The switching oscillator resistor is connected between the $R_{SW\text{-}OSC}$ pin and the V_{DD} supply. The switching frequency is inversely proportional to the resistor value, dropping as the resistance increases.
Inductor L	The inductor provides the voltage boost needed by means of inductive “flyback”. The internal MOSFET switch alternately opens and closes the ground connection for the inductor at the L_X pin. When this internal switch opens, the inductor potential will forward-bias the catch diode and the current will pass through the storage capacitor C_S, charging it to a high voltage. Smaller inductors are preferred to prevent saturation. As the value of the inductor increases (and the series DC resistance of the inductor decreases), the switching frequency set by R_{SW} should be increased to prevent saturation. In general, smaller value inductors that can handle more current are more desirable when larger area EL lamps must be driven.
Lamp, R_{CL}	An external resistor (R_{CL}) in series with the lamp will protect the output drivers from high transient currents during lamp commutation.

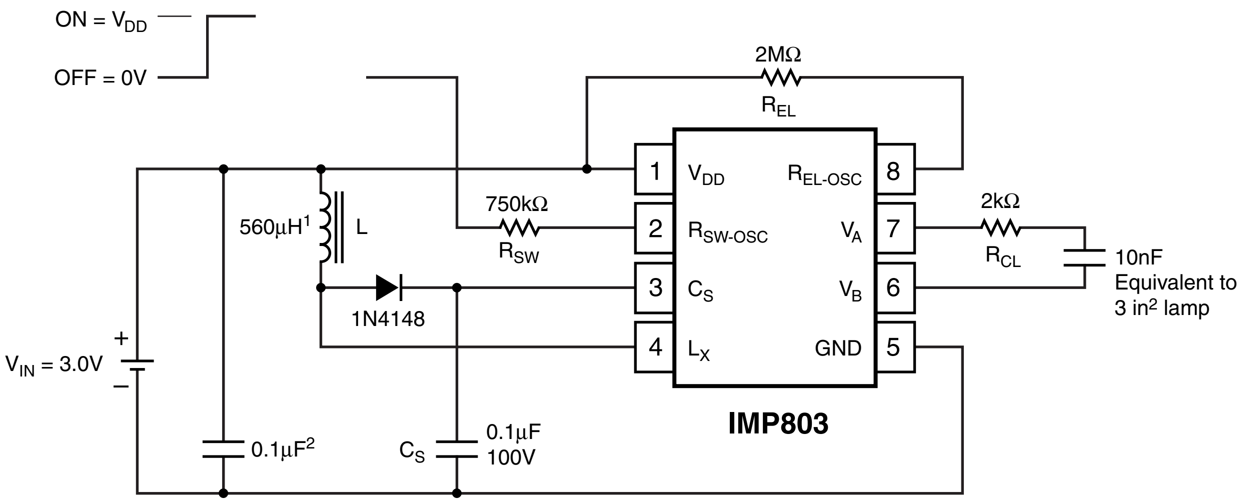
High Voltages Present

The IMP803 generates high voltages and caution should be exercised.

Application Information

Test and Application Circuit, 3.0V

Figure 1 shows the IMP803 configured to drive a 3-square-inch EL lamp, represented as a 10nF capacitor. With a 3.0V input, the EL lamp will be driven to moderate brightness.



Note:

1. Murata part # LQH4N561K04 (DC resistance <14.5 Ω)

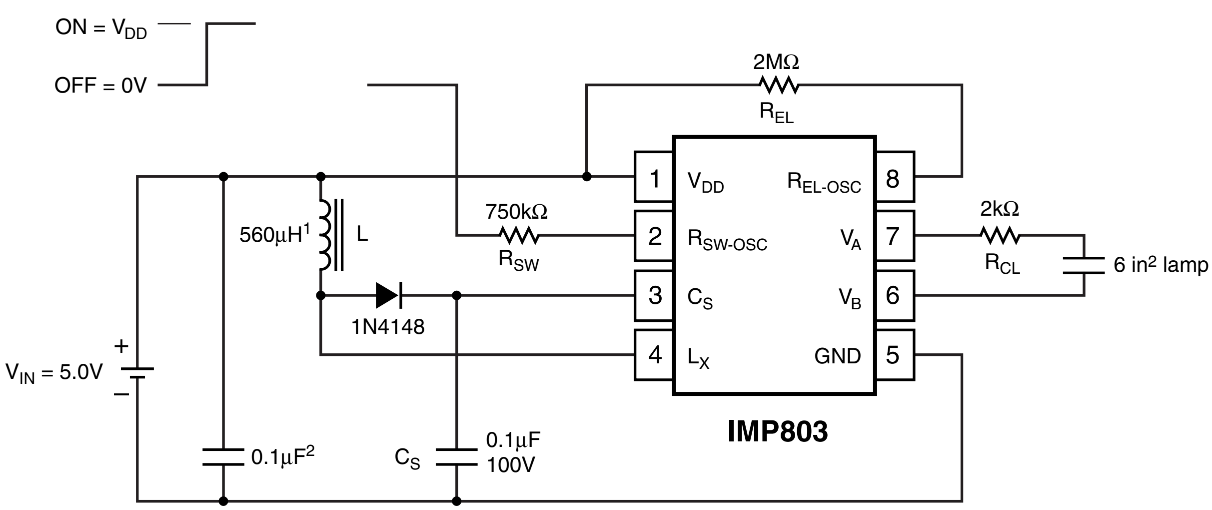
2. Larger values may be required depending upon supply impedance.

803_09.eps

Figure 1. 3.0V Application

Test and Application Circuit, 5.0V

Figure 2 shows a 5.0V input application driving a 6-square-inch EL lamp.



Note:

1. Murata part # LQH4N561K04 (DC resistance <14.5 Ω)

2. Larger values may be required depending upon supply impedance.

803_10.eps

Figure 2. 5.0V Application

Test and Application Circuit, 6.0V

At higher input voltage levels, the IMP803 will drive large EL lamps. *Figure 3* shows a 6.0V circuit configuration that will drive a 10 square-inch lamp.

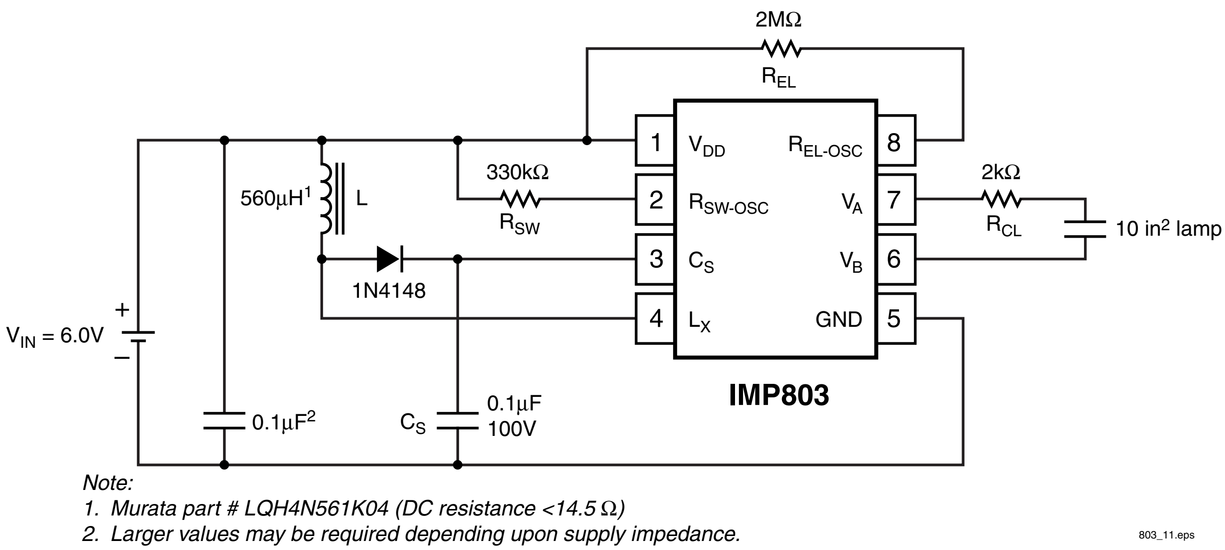


Figure 3. 6.0V Application

Enable/Disable Operation

Figure 4 shows that the IMP803 can be enabled via a logic gate that connects R_{SW} to V_{DD}, and disabled by connecting it to ground.

Enable/Disable Table

R_{SW} Connection	IMP803 State
V_{DD}	Enabled
GND	Disabled

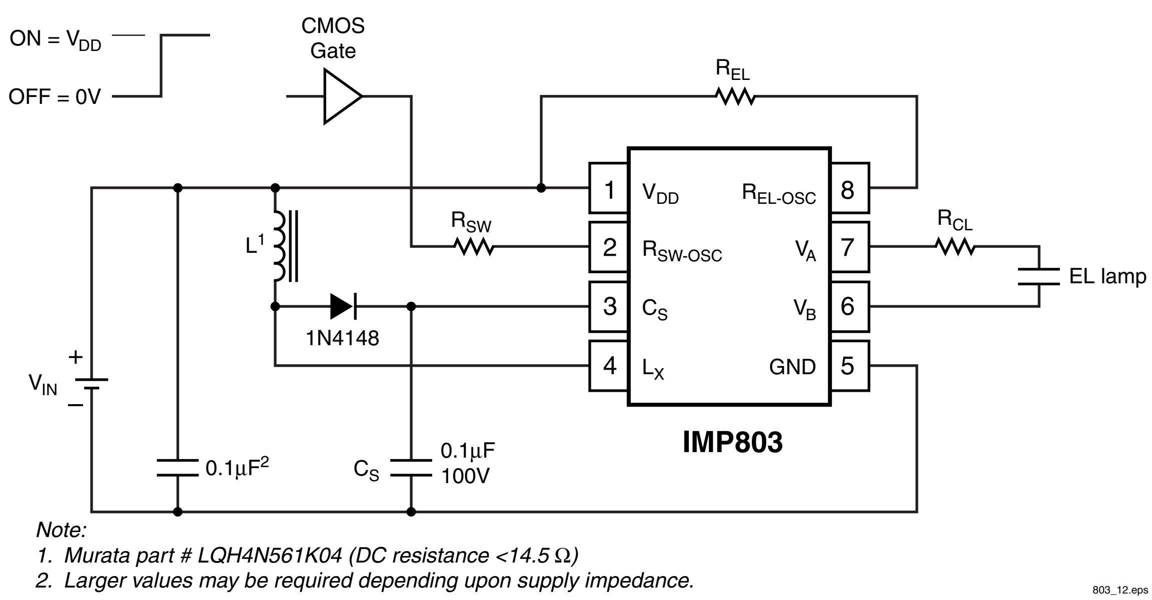


Figure 4. Enable/Disable Operation

Dual Supply Operation with 1.5V Battery

The IMP803 can also be operate from a single battery cell when a regulated voltage higher than 2.0V is also available. This dual supply configuration, shown in *Figure 5*, uses the regulated voltage to operate the IMP803 while the energy for the high-voltage boost circuit comes from the battery.

The circuit of *Figure 5* thus allows operation with batteries that are below the 2V minimum specification or above the 6.0V maximum operating voltage.

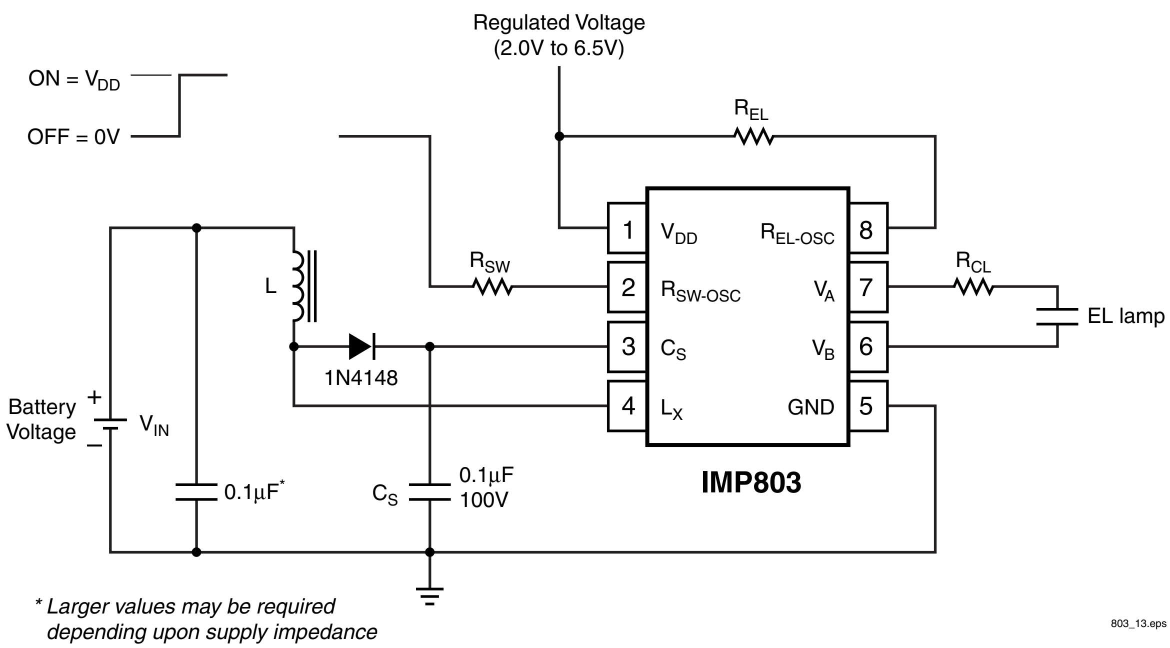


Figure 5. Dual Supply Operation

Switch Resistance

The IMP803 inductor switch resistance is typically below 3.5Ω, as shown in *Figure 6*.

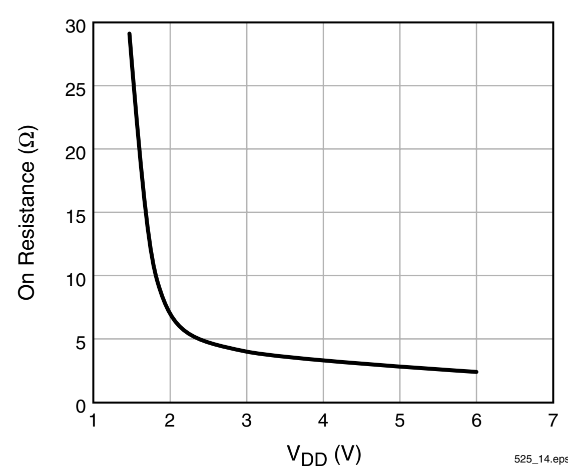


Figure 6. Boost Switch On Resistance

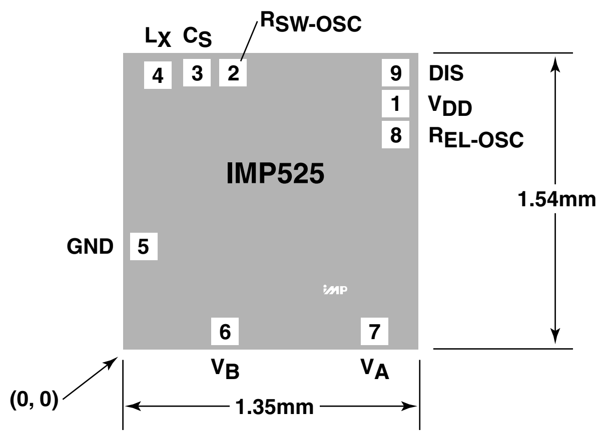
Notes

Project

IMP525
Single Cell Battery Powered EL Lamp Driver

General Information

Die Thickness:	25 mils (625 microns)
Bond Wire Size:	1.0 mil (25 microns)
Back Side Metal:	None
Back Side Potential:	Ground
Die Attach Method:	Conductive Adhesive
Bond Pad Metal:	Aluminum, 1% Silicon, 1/2% Copper
Bond Pad Size:	100 microns per side
Die Size:	1.35mm x 1.54mm



Pad Description

Pad Number	Name	Function
1	V_{DD}	Positive voltage supply.
2	R_{SW-OSC}	Switch-mode oscillator frequency setting pad.
3	C_S	Boost converter storage capacitor pad.
4	L_X	Inductor pad.
5	GND	Ground pad.
6	V_B	EL lamp drive.
7	V_A	EL lamp drive.
8	R_{EL-OSC}	EL lamp oscillator frequency setting pad.
9*	DIS	Disable pad. DIS = HIGH disables chip.

** See Ordering Information table*

Pad Location[1]

Pad Number	X (microns)	Y (microns)
1	1153	1092
2	476	1226
3	314	1226
4	143	1216
5	111	460
6	397	112
7	1104	112
8	1153	958
9	1153	1226

Notes 1. To bonding pad center

Ordering Information

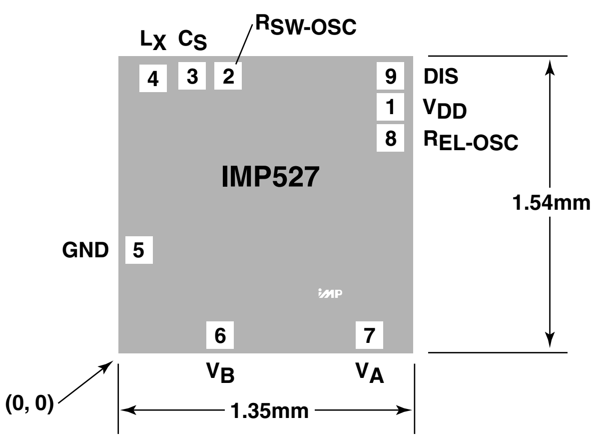
Part Number	Pad Number	Description: Disable Pad Active	Description: Disable Pad Not Active
IMP525/D	9		●
IMP525/D1	9	●	

525 Die_t01

IMP527
Single Cell Battery Powered EL Lamp Driver, 180V_{PP} Drive

General Information

Die Thickness:	25 mils (625 microns)
Bond Wire Size:	1.0 mil (25 microns)
Back Side Metal:	None
Back Side Potential:	Ground
Die Attach Method:	Conductive Adhesive
Bond Pad Metal:	Aluminum, 1% Silicon, 1/2% Copper
Bond Pad Size:	100 microns per side
Die Size:	1.35mm x 1.54mm



Pad Description

Pad Number	Name	Function
1	V_{DD}	Positive voltage supply.
2	R_{SW-OSC}	Switch-mode oscillator frequency setting pad.
3	C_S	Boost converter storage capacitor pad.
4	L_X	Inductor pad.
5	GND	Ground pad.
6	V_B	EL lamp drive.
7	V_A	EL lamp drive.
8	R_{EL-OSC}	EL lamp oscillator frequency setting pad.
9*	DIS	Disable pad. DIS = HIGH disables chip.

** See Ordering Information table*

Pad Location[1]

Pad Number	X (microns)	Y (microns)
1	1153	1092
2	476	1226
3	314	1226
4	143	1216
5	111	460
6	397	112
7	1104	112
8	1153	958
9	1153	1226

Notes 1. To bonding pad center

Ordering Information

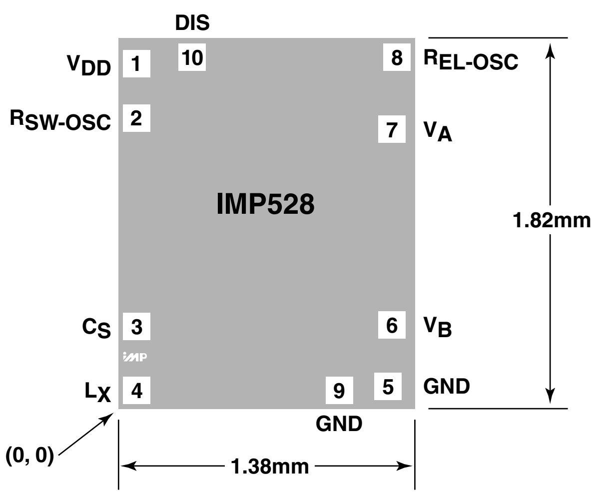
Part Number	Disable Pad Number	Description: Disable Pad Active	Description: Disable Pad Not Active
IMP527/D	9		●
IMP527/D1	9	●	

527 Die_t01

IMP528
High-Voltage EL Lamp Driver, 220V_{PP} Drive

General Information

Die Thickness:	25 mils (625 microns)
Bond Wire Size:	1.0 mil (25 microns)
Back Side Metal:	None
Back Side Potential:	Ground
Die Attach Method:	Conductive Adhesive
Bond Pad Metal:	Aluminum, 1% Silicon, 1/2% Copper
Bond Pad Size:	100 microns per side
Die Size:	1.38mm x 1.82mm



Pad Description

Pad Number	Name	Function
1	V_{DD}	Positive voltage supply.
2	R_{SW-OSC}	Switch-mode oscillator frequency setting pad.
3	C_S	Boost converter storage capacitor pad.
4	L_X	Inductor pad.
5	GND	Ground pad.
6	V_B	EL lamp drive.
7	V_A	EL lamp drive.
8	R_{EL-OSC}	EL lamp oscillator frequency setting pad.
9	GND	Ground pad.
10*	DIS	Disable pad. DIS = HIGH disables chip.

** See Ordering Information table*

Pad Location[1]

Pad Number	X (microns)	Y (microns)
1	152	1480
2	152	1253.5
3	152	387.75
4	152	122.5
5	1198.5	140
6	1215	395
7	1215	1208.5
8	1234	1508.5
9	998	122.5
10	382	1553.5

Notes 1. To bonding pad center

Ordering Information

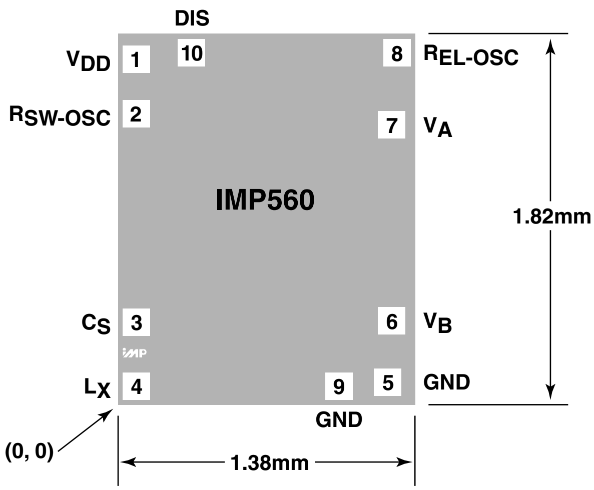
Part Number	Disable Pad Number	Description: Disable Pad Active	Description: Disable Pad Not Active
IMP528/D	10		●
IMP528/D1	10	●	

528 Die_t01

IMP560
Power Efficient EL Lamp Driver

General Information

Die Thickness:	25 mils (625 microns)
Bond Wire Size:	1.0 mil (25 microns)
Back Side Metal:	None
Back Side Potential:	Ground
Die Attach Method:	Conductive Adhesive
Bond Pad Metal:	Aluminum, 1% Silicon, 1/2% Copper
Bond Pad Size:	100 microns per side
Die Size:	1.38mm x 1.82mm



Pad Description

Pad Number	Name	Function
1	V_{DD}	Positive voltage supply.
2	$R_{SW\text{-}OSC}$	Switch-mode oscillator frequency setting pad.
3	C_S	Boost converter storage capacitor pad.
4	L_X	Inductor pad.
5	GND	Ground pad.
6	V_B	EL lamp drive.
7	V_A	EL lamp drive.
8	$R_{EL\text{-}OSC}$	EL lamp oscillator frequency setting pad.
9	GND	Ground pad.
10*	DIS	Disable pad. DIS = HIGH disables chip.

** See Ordering Information table*

Pad Location[1]

Pad Number	X (microns)	Y (microns)
1	152	1480
2	152	1253.5
3	152	387.75
4	152	122.5
5	1198.5	140
6	1215	395
7	1215	1208.5
8	1234	1508.5
9	998	122.5
10	382	1553.5

Notes 1. To bonding pad center

Ordering Information

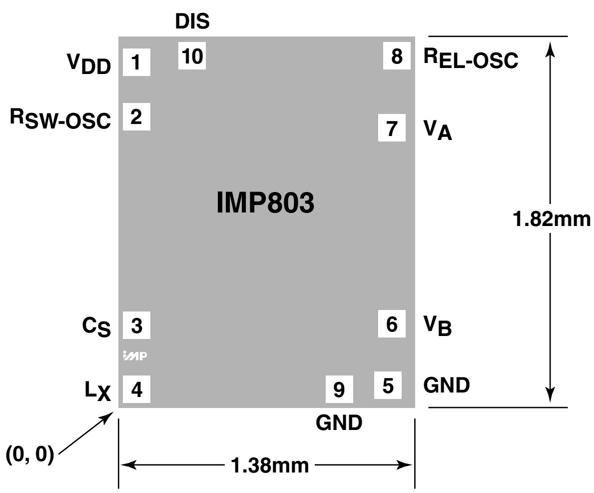
Part Number	Pad Number	Description: Disable Pad Active	Description: Disable Pad Not Active
IMP560/D	10		●
IMP560/D1	10	●	

560 Die_t01

IMP803
High-Voltage EL Lamp Driver

General Information

Die Thickness:	25 mils (625 microns)
Bond Wire Size:	1.0 mil (25 microns)
Back Side Metal:	None
Back Side Potential:	Ground
Die Attach Method:	Conductive Adhesive
Bond Pad Metal:	Aluminum, 1% Silicon, 1/2% Copper
Bond Pad Size:	100 microns per side
Die Size:	1.38mm x 1.82mm



Pad Description

Pad Number	Name	Function
1	V_{DD}	Positive voltage supply.
2	$R_{SW\text{-}OSC}$	Switch-mode oscillator frequency setting pad.
3	C_S	Boost converter storage capacitor pad.
4	L_X	Inductor pad.
5	GND	Ground pad.
6	V_B	EL lamp drive.
7	V_A	EL lamp drive.
8	$R_{EL\text{-}OSC}$	EL lamp oscillator frequency setting pad.
9	GND	Ground pad.
10*	DIS	Disable pad. DIS = HIGH disables chip.

** See Ordering Information table*

Pad Location[1]

Pad Number	X (microns)	Y (microns)
1	152	1480
2	152	1253.5
3	152	387.75
4	152	122.5
5	1198.5	140
6	1215	395
7	1215	1208.5
8	1234	1508.5
9	998	122.5
10	382	1553.5

Notes 1. To bonding pad center

Ordering Information

Part Number	Pad Number	Description: Disable Pad Active	Description: Disable Pad Not Active
IMP803SX	10		●
IMP803/D1	10	●	

803 Die_t01

Notes

Project

Electroluminescent Lamp Driver Evaluation Board

Introduction

This Application Note introduces an Evaluation Board for IMP EL driver ICs. It is supplied with the IMP803 but can also be used with the IMP560 and IMP525: all 3 have identical pinouts.

EL Lamps and Drivers

An electroluminescent (EL) lamp consists of a phosphor coating on a dielectric that is sandwiched between two conductors. Electrically, it looks like a capacitor. Such a lamp requires drive from a high alternating voltage source in order to emit light. This can be obtained from IMP integrated circuits IMP803, IMP560 and IMP525 that convert low voltages into appropriate high-voltage waveforms.

Small EL lamps exhibit about 2 to 6nF/in^2. IMP Driver ICs are capable of powering EL lamps that have total equivalent load capacitances up to 30nF, so this works out to a maximum of around 15 square inches. "Powering" in this context means enabling enough light for the application, which can range from LCD backlights (relatively bright in a handheld device) to pagers (medium-bright, in a poorly-lit room), to night-lights (faint, in a dark room).

IMP Driver IC System Diagram

As shown in *Figure 1*, these ICs contain a high-voltage MOSFET switch, an output H-bridge, and oscillators to drive each. The switch, combined with an external inductor and diode, form a step-up (boost) converter that transforms the input voltage to 45-90 volts across capacitor C_S. This, in turn, is switched from one side of the load (the EL lamp) to the other by a commutating bridge, driven by its own oscillator. This action causes the lamp to experience twice the C_S value (i.e. 90-180 volts peak-to-peak) with no DC component.

A typical application uses a switch frequency of 80kHz and bridge commutation frequency of 360Hz. These frequencies are controllable via external resistors; R_{SW} for the boost converter and R_{EL} for the output driver. R_{EL} influences brightness, color and EL lamp life. R_{SW} controls converter efficiency. Both affect power consumption.

IMP Driver IC System Diagram

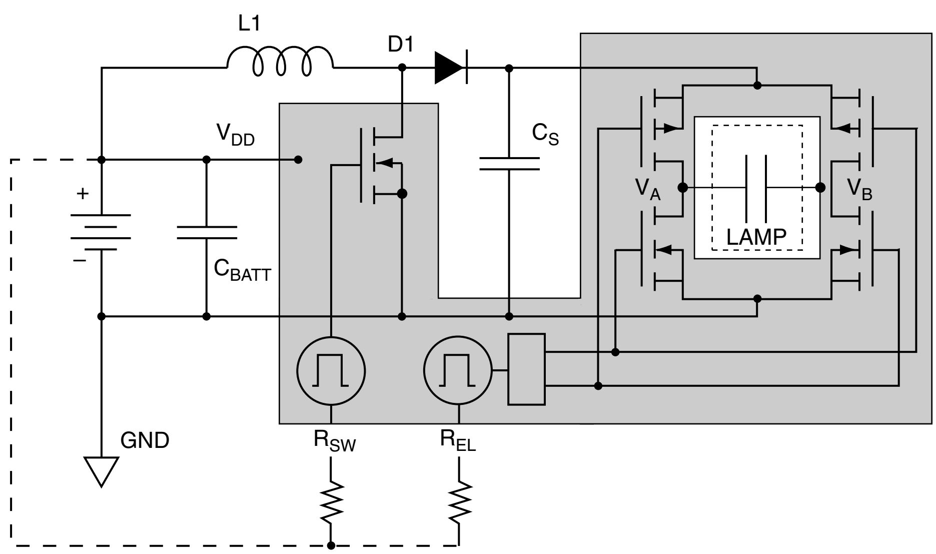


Figure 1. Circuitry in gray is on-chip.

Driver Variations

The IMP803, 560 and 525 have an internal regulating circuit (see *Figure 2*), that is useful where V_{IN} is expected to change considerably, as with an aging battery: as V_{IN} falls, V_{OUT} (and brightness) will remain substantially unaffected.

Table 1 is a general comparison of IMP EL Lamp drivers. It facilitates choices based on number of batteries, size of display, and regulation. Required display brightness will also need to be factored into the choice.

Table 1. General Characteristics of IMP EL Lamp Drivers

Device	V_{IN}	V_{OUT}	Regulated Output	Max. Switch R(on)
IMP803	2.4 – 6.5V	$180V_{PP}$	Yes	8Ω
IMP560	2.4 – 6.5V	$120V_{PP}$	Yes	8Ω
IMP525	0.9 – 2.5V	$112V_{PP}$	Yes	15Ω

AN01.t01

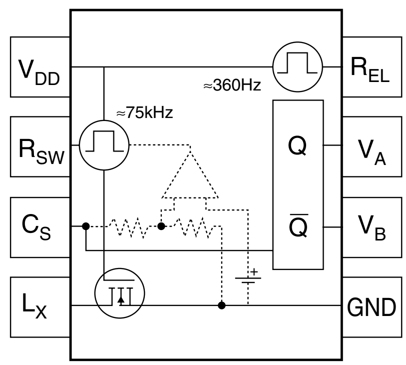


Figure 2. Block Diagram for IMP circuits. Dotted components are equivalent to regulation circuitry (see text).

Basic Circuit, Plus Variations

In normal operation, V_{DD} is one or two 1.5V cells and L1 is a tiny ferrite-bobbin inductor. R_{SW} and R_{EL} control their respective oscillators. If a logic-controllable shutdown is desired, R_{SW} may be switched between V_{DD} and GND (I_{DDQ} = 1µA max.). Conversely, if shutdown is via V_{DD}, R_{SW} should then be connected to V_{DD} as shown by the dotted line in *Figure 3*.

R_{CL} is included to protect the bridge against peak currents during commutation. A value of 500Ω to 2kΩ is suitable.

In use, the inductor current can reach several tens of milliamperes, so in single-battery applications it is recommended that the low-current shutdown capability of the driver IC be utilized. This is done by connecting R_{SW} (point A on the schematics) to either V_{DD} (ON) or GND (OFF). With power source(s) connected, shutdown (standby) current is typically much lower than 1µA.

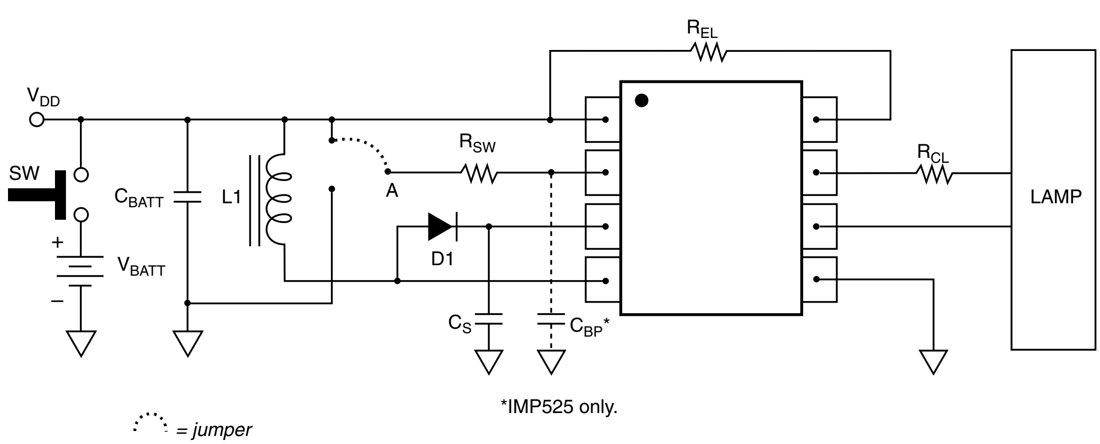


Figure 3. Basic EL Lamp Driver.

Reducing Component Count

Having said that keeping R_{CL} is a good idea, it is true that removing as many components as possible may also be desirable. For the IMP803, R_{EL} and R_{SW} may be combined as shown in *Figure 4*. Varying R_{EL} causes a visible change in brightness and color, but a similar variation in R_{SW} (affecting oscillator frequency and power consumption) is much less noticeable. Combining the two is thus a valid way to save a resistor. The bypass capacitor C_{BP} (IMP525 only) reduces display flicker in noisy environments, such as when there is no ground plane.

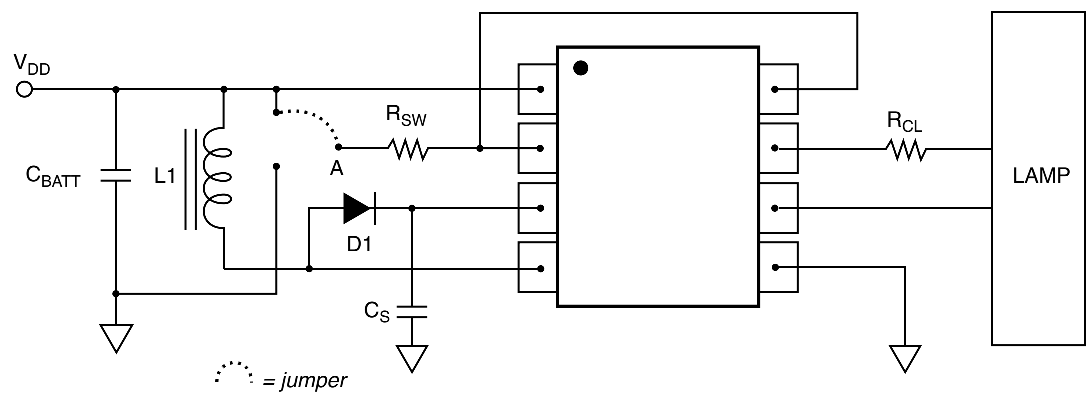


Figure 4. Using R_{SW} to supply current for both switch and EL oscillators, and also serve as a low-current on/off switch (IMP803 only).

Using the circuit in *Figure 5*, one can utilize an available V_{IN} that is higher or lower than the allowable V_{DD}. The logic shutdown may also be separated from V_{DD}. Such arrangements are helpful when the inductor supply is too low for the IC, or the display size requires a voltage that is too high for the IC. A higher V_{IN} will need a higher switching frequency to keep the inductor out of saturation. In all cases, note the presence of HIGH VOLTAGE!

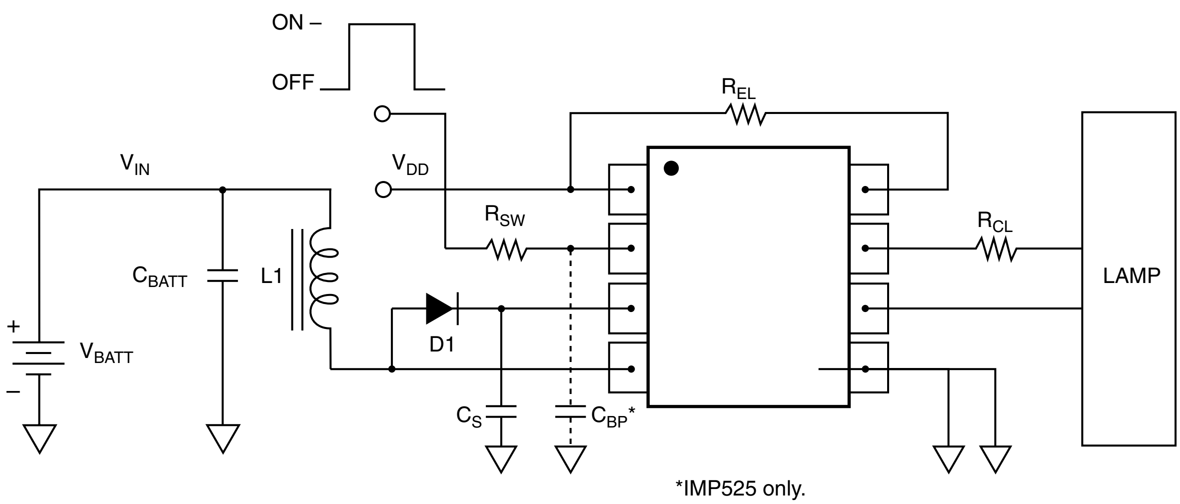


Figure 5. General Circuit, where chip V_{DD}, on/off logic and V_{IN} are all different.

Evaluation Board

The ELD002 is a PC board for evaluation and experimentation purposes. More compact arrangements are easily achieved by using surface-mounted components exclusively. The various possible connections mirror the options discussed in the data sheet and the Application Note.

The two dark patches are the connections for the EL lamp which are made using conductive double-sided tape. The display itself is held down with ordinary double-sided tape. Taping is advantageous for several reasons, among which are that lamps with staked connecting terminals generally cost more, and they are a possible site for mechanical (and thus electrical) failure.

As a general precaution, note that HIGH VOLTAGE exists on the board; around 180V or so. The current level is low so there is no danger, except possible pain if a tender skin area or open cut contacts the HV sections.

There are extra holes for capacitors (if needed), and the hole spacings are wide enough to accommodate 1/4W resistors. Corner mounting holes have also been provided.

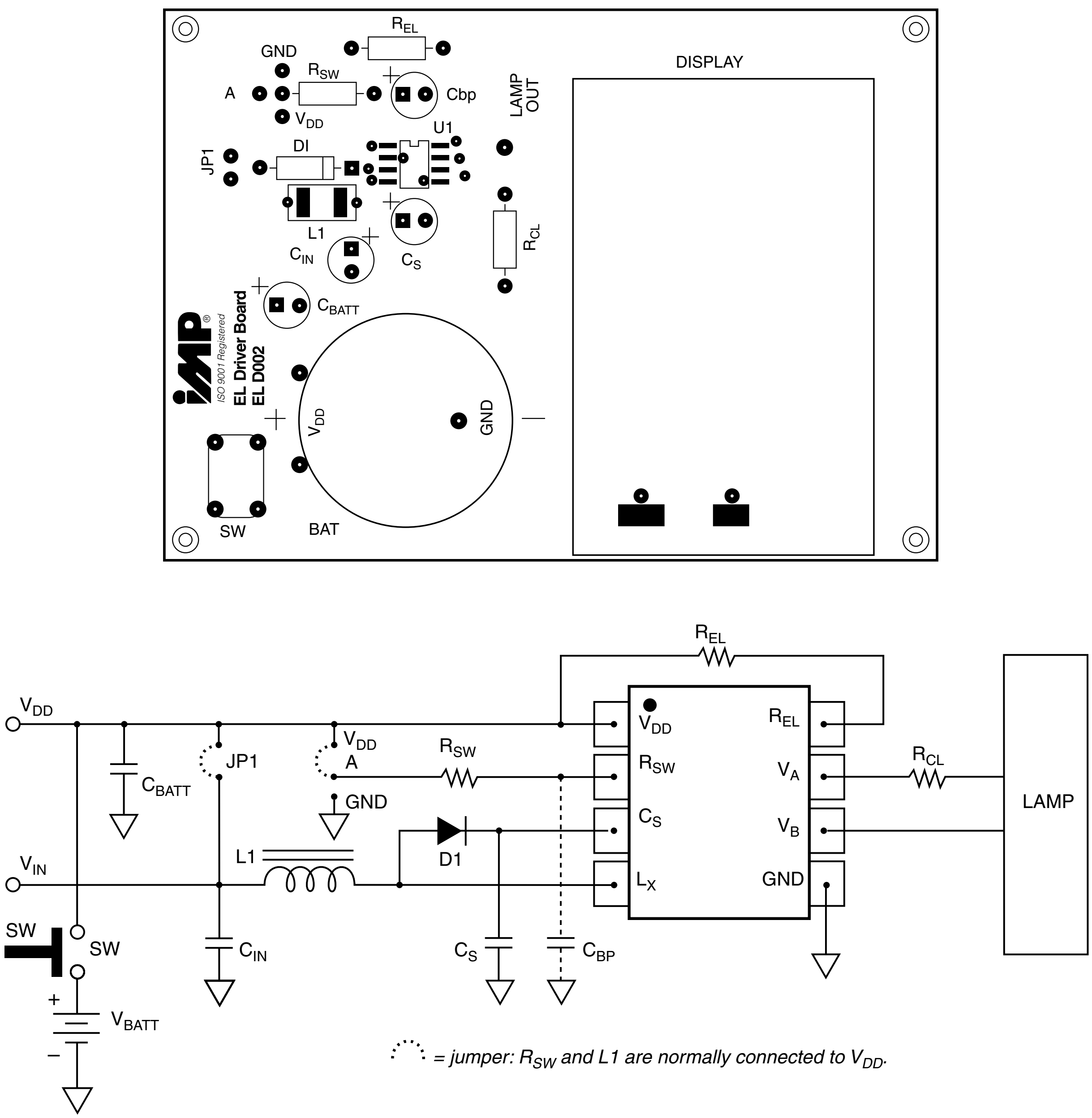


Figure 6. Evaluation Board Layout and Schematic.

Some Battery Considerations

To keep the board light in weight, a Li-Mn power source was selected. When energized, the drain from the circuit is around 22mA, thus the CR battery chemistry is preferred over the BR for its superior pulse performance. If long-term continual illumination is anticipated and space is not an issue, alkaline batteries may be more economical.

With the IMP803 and 560µH inductor supplied, regulation begins at about 3-3.5V, but display illumination appears virtually unchanged above 2.7V. When choosing the battery chemistry, it is a good idea to match the cell "plateau" voltages to this. For example, a typical NiCad plateau is 1.2V under load, so more than 2 cells would be needed. Alkaline plateaus are somewhat higher, and they differ with size, shape and duty, so 2 cells could suffice. Li-Mn coin cells have their voltage plateau under load at about 2.85 volts. They can drop lower, but they also return to close to 3V when the load is removed.

Additional Points

1) To experiment with the *Figure 4* scheme, a jumper may be run from the rightmost pad of R_{EL} to the leftmost pad of C_{BP} (with the + above it). Start with an R_{SW} of 750kΩ. Short leads and a ground plane are more critical in this arrangement.
2) C_S should be 10nF - 100nF.
3) The IMP803, IMP560 and IMP525 datasheets show performance with different inductors. For example, high-voltage regulation is reached earlier with lower L, but this requires more current. This may be partially offset by adjustment of the oscillator resistors.
4) To experiment with multiple supplies, the appropriate jumpers may be removed.
5) The inclusion of R_{CL} should be stressed: while 500Ω to 10kΩ has been used, 2kΩ is the best all-around value.

Layout Rules for Other Arrangements

1) A ground plane is recommended to keep stray high frequencies confined. In a very small area, the need for a ground plane may be nil. A totally surface-mount arrangement would make such a plane difficult anyway.
2) Locate high voltages away from the high-impedance elements R_{EL} and R_{SW}.
3) Make sure that C_S has a rating of at least 100V.
4) The diode should have good reverse-recovery characteristics (the general-purpose 1N4148 is adequate) and should be rated for pulsed BV > 100V for the IMP803, and pulsed BV > 75V for the IMP560 and IMP525.
5) Shutdown by a logic-level signal is possible by connecting R_{SW} to ground (R_{SW} is normally connected to V_{DD}). This on/off logic uses only 1µA max. when connected at this location.
7) Required voltage ratings for the capacitors other than C_S are flexible, and need only reflect actual stresses plus a safety margin.

Bill of Materials

Component	Description	Manufacturer	Part Number
Resistors (±5%)	See Table, below		
Capacitors (±20%)	See Table, below	Murata	RPE121/122 Series
Switch	SPST, momentary	Panasonic	P8008S
Battery	3.0V Li-Mn Coin	Sony Panasonic	CR2450-HE4 CR2354-IGU
Inductor	L1 = 560µH	Murata	LQH4N561K04
Diode	D1 = 1N4148		
Lamp	1.3” x 2.05”	MetroMark or other	
Conductive Tape	Connects display	Adhesives Research	ARclad 8001
Double-Sided Tape	Holds display down	3M	Type 665

Key to Components and Ratings

Component	Value	Function	Comments
R_{SW}	30kΩ to 3MΩ	Sets switch osc. frequency.	Decrease R to increase frequency.
R_{EL}	500kΩ to 10MΩ	Sets bridge osc. frequency.	Decrease R to increase frequency.
R_{CL}	500Ω to 2kΩ	Limits output current.	Protects IC.
C_S	0.01µF to 0.1µF, 100V	Stores high voltage.	Use low values for large lamps.
C_{BATT}	0.1µF, 10V	Supply bypass.	Keeps supply impedance low.
C_{BP}	1nF, 10V	Lowers noise at R_{SW}.	IMP525 only.
C_{IN}	0.1µF to 22µF	Supply bypass.	Keeps supply impedance low.
L1	100µH to 1mH	Stores energy.	Small L, high f increases V_{OUT}.
D1	100V, 10mA (1N4148)	Passes energy from L to C_S.	Use fast recovery type.

APPENDIX: Introduction to EL Lamps

Chemical compounds, called phosphors, glow when energy is applied to them. This excitation energy can come from conducted or radiated electrons, or an electric field. A common example of this process is found in the emitted (radiated) electrons that impinge on the dots and stripes of color monitors and TVs, whose phosphors emit everything from pure colors to white light, depending on their formulations.

Backlights and lamps generally are simpler, employing a manganese-activated zinc sulfide phosphor (ZnS:Mn) that is excited by a high-voltage (> 40V) AC electric field (DC can shorten the lamp life). Fabrication involves depositing the phosphor as a thin film onto a BaTiO3 dielectric between conducting planes, like a capacitor: one of the planes is the transparent conductor, indium tin oxide (ITO). The lamp color depends on phosphor formulation, but also on its physical realization (i.e. encapsulation, resins, dyes, etc.), plus the characteristics of the drive circuitry.

The IMP line of drivers is targeted mainly at applications like backlight EL and stand-alone pre-printed or segmented lamps. Backlights are used with the Liquid Crystal Displays (LCDs) found in cellular telephones, pagers, Personal Digital Assistants (PDAs), and general-purpose local lighting applications where low power consumption without heat is important (e.g. airline cockpits, medical instrumentation).

The excitation required for lamps ranges from tens to hundreds of volts, at frequencies from 60Hz to a few kHz. Each display has an optimum combination depending on size, color, efficiency and desired brightness.

In general, the changes in brightness with frequency and voltage are nearly linear. These facts allow tradeoffs. For example, if going above a certain voltage is not allowed, an increase in drive frequency may achieve the same result.

EL Driver Demonstration PC Boards, IMP-DBM and IMP-DBS

Introduction

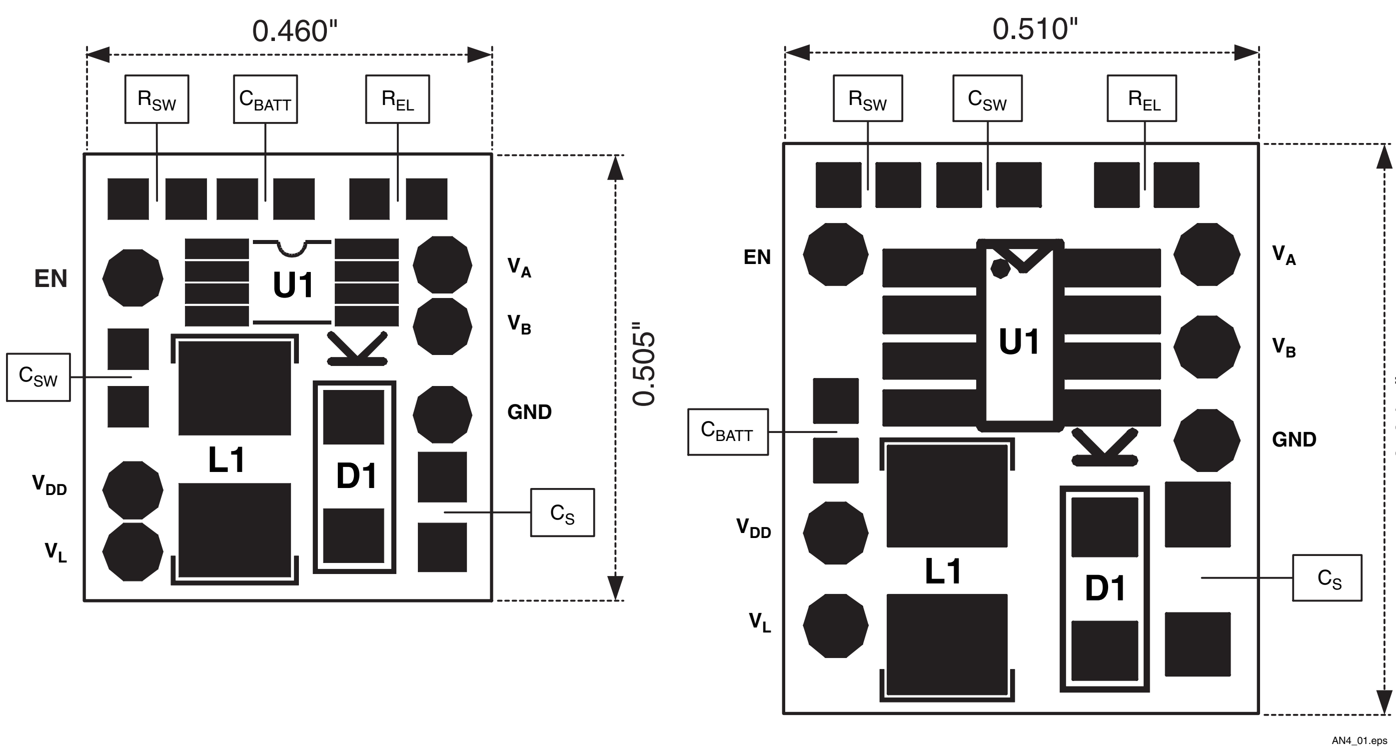
These Demonstration Boards provide a platform for demonstration and experimentation with IMP's EL lamp drivers IMP803, IMP560 and IMP525. The PC board has space for all of the components required for a complete application circuit. In addition, compact size facilitates their use in prototype systems.

For normal operation, the enable pad (EN), the V_{DD} pad and the V_L pad are all connected to the positive supply voltage. If the board is located far from the supply, a 10µF/10V tantalum capacitor from V_L to GND should be used to keep supply impedance low (This cap, or its equivalent, is normally present in a manufactured circuit). Also, better noise immunity may be achieved by utilizing separate wires for the V_L and V_{DD} connections.

The C_{BATT} capacitor is used to bypass the supply pin of the IC. The C_{SW} capacitor (IMP525 only) is utilized to reduce noise on the high impedance R_{SW} pin. C_{SW} should never be greater than 100pF since this can result in instability of the 525's internal oscillator.

The layout was designed to reduce the effects of noise through use of a ground plane and by separation of the high-current components (inductor, diode, and reservoir capacitor) from the high-impedance portion of the circuit (the high-value frequency-setting resistors). Additionally, the lengths of high-current traces were minimized.

If parts are replaced or exchanged by hand- soldering, care should be taken to thoroughly clean the residual flux from the board surface. Otherwise, resultant leakage currents may prevent proper operation of the part. The tight spacing and high impedances of input nodes on the PCB exacerbate this effect. The predominant impact of PCB leakage is a shift in the switch and commutation frequencies away from their designed values due to leakage currents from the R_{SW} and R_{EL} pins.



DBM board, for MicroSO package

DBS board, for SO package

Figure 1. Top View of Printed Circuit Board

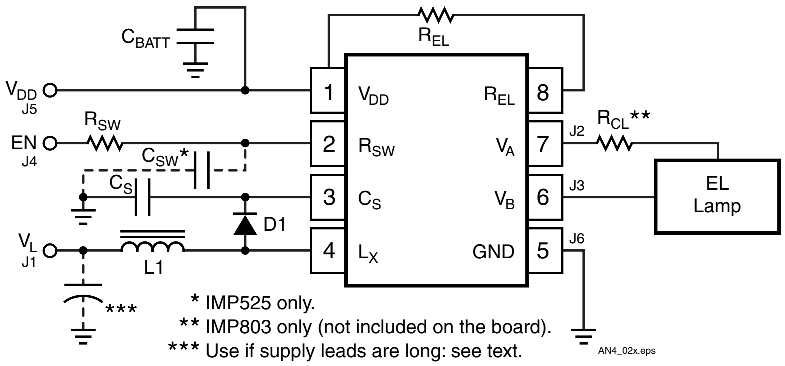


Figure 2. Demonstration Board Schematic.

Table 1. Bill of Materials (use as required)

Component	Package	Manufacturer and Part Number	IMP803	IMP560	IMP525
R_{SW}	0603	Any	750kΩ	750kΩ	1MΩ
R_{EL}	0603	Any	2MΩ	2MΩ	1MΩ
R_{CL}	0603	Any	510Ω	—	—
L1	1812	Murata LQH4N561K04	560µH	560µH	560µH
C_S	0805	NovaCap 0805B683K101NT	68nF/100V	68nF/100V	68nF/100V
D1	SOD80	4148-type	100V	75V	75V
C_{BATT}	0603	Any	100nF	100nF	100nF
C_{SW}	0603	Any	—	—	100pF, max

AN04.t01

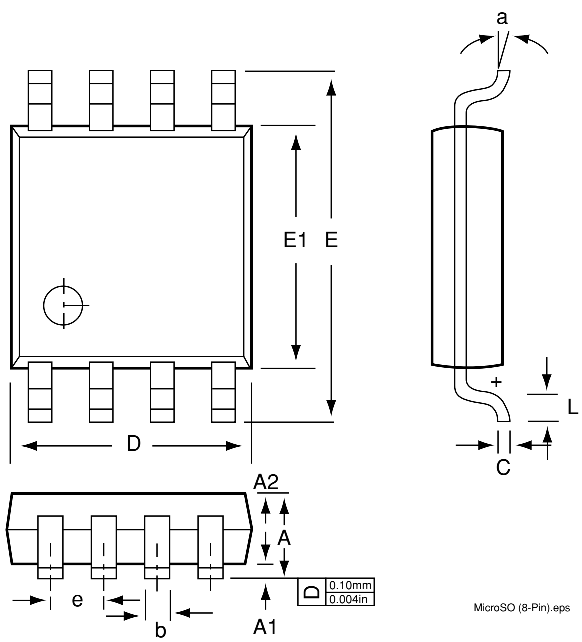
Table 2. Component Description Table

Component	Function	Comments
R_{SW}	Sets switch frequency	Decreasing R increases frequency.
R_{EL}	Sets commutation frequency	Decreasing R increases frequency.
R_{CL}	Limits output current	Optional *external* part: protects bridge if $V(C_S)$ > 80V (IMP803 only).
L1	Boost inductor	Delivers energy to C_S.
C_S	Reservoir capacitor	Delivers energy to commutating bridge.
C_{SW}	Noise reduction capacitor	Optional, use if flickering is observed (IMP525 only).
C_{BATT}	Supply bypass capacitor	Optional (use if missing from external circuit)
D1	Catch diode	Fast recovery diode recommended. Observe BV_{REV}.

AN04.t02

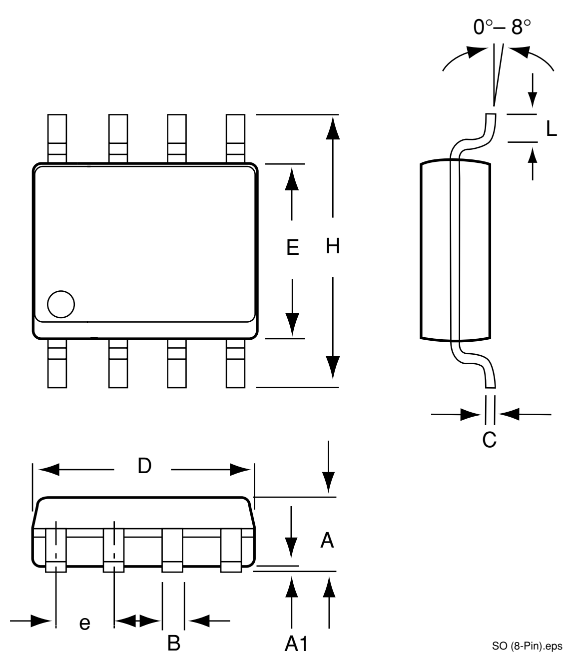
Package Dimensions

MicroSO (8-Pin)



Parts/Reel	3000

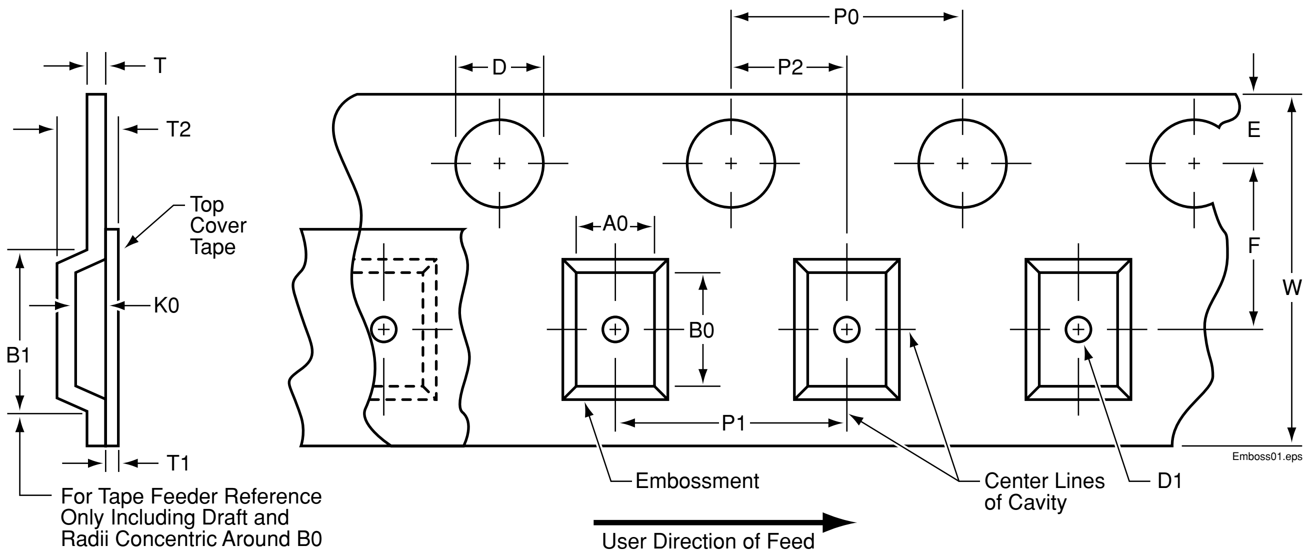
SO (8-Pin)



Parts/Reel	3000

	Inches		Millimeters	
	Min	Max	Min	Max
MicroSO (8-Pin)				
A	———	0.0433	———	1.10
A1	0.0020	0.0059	0.050	0.15
A2	0.0295	0.0374	0.75	0.95
b	0.0098	0.0157	0.25	0.40
C	0.0051	0.0091	0.13	0.23
D	0.1142	0.1220	2.90	3.10
e	0.0256 BSC		0.65 BSC	
E	0.193 BSC		4.90 BSC	
E1	0.1142	0.1220	2.90	3.10
L	0.0157	0.0276	0.40	0.70
a	0°	6°	0°	6°
SO (8-Pin)				
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.013	0.020	0.33	0.51
C	0.007	0.010	0.19	0.25
e	0.050		1.27	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
L	0.016	0.050	0.40	1.27
D	0.189	0.197	4.80	5.00

Tape Schematic[5]



Embossed Tape — Constant Dimensions

Tape Size	D	E	P0	P2	T Max.	T1 Max.
8mm and 12mm	1.5 $^{+0.10}_{-0.0}$ (0.59 $^{+0.004}_{-0.0}$)	1.75 ± 0.10 (0.069 ± 0.004)	4.0 ± 0.10 (0.157 ± 0.004)	2.0 ± 0.05 (0.079 ± 0.002)	0.600 (0.024)	0.10 (0.004)

ELD/B_t02.at3

Embossed Tape — Variable Dimensions

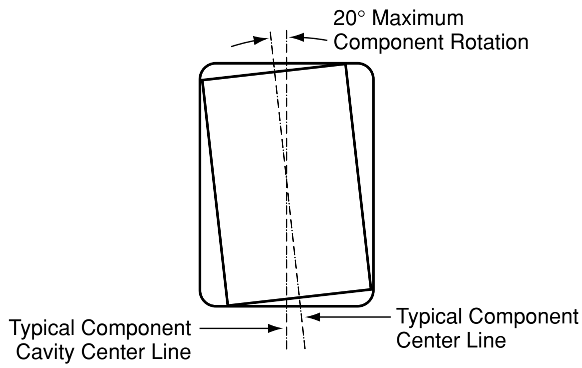
Tape Size	A0, B0, K0	B1 See Note 4	D1 See Note 3	F	T2	P1	W
8mm 1/2 Pitch	See Note 1	4.55 (0.179)	1.0 (0.039)	3.5 ± 0.05 (0.138 ± 0.002)	2.5 Max. (0.098)	2.0 ± 0.10 (0.079 ± 0.004)	8.0 $^{+0.3}_{-0.1}$ (0.315 $^{+0.012}_{-0.004}$)
8mm						4.0 ± 0.10 (0.157 ± 0.004)	
12mm	See Note 1	8.2 (0.323)	1.5 (0.059)	5.5 ± 0.05 (0.217 ± 0.002)	6.5 Max. (0.256)	4.0 ± 0.10 (0.157 ± 0.004)	12.0 ± 0.30 (0.472 ± 0.012)
12mm Double Pitch						8.0 ± 0.10 (0.315 ± 0.004)	

ELD/B_t03.at3

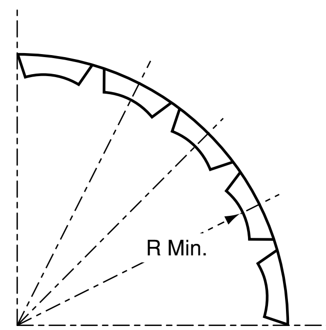
Notes:
1. *A0, B0 and K0 are determined by the maximum dimensions to the ends of the terminals extending from the component body and / or the body dimensions of the component. The clearance between the ends of the terminals or body of the component to the sides and depth of the cavity (A0, B0 and K0) must be within 0.05mm (0.002) minimum and 0.50mm (0.020) maximum. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20 degrees (see Component Rotation).*
2. *Tape with components shall pass around radius.*
3. *The embossment hole location shall be measured from the spocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.*
4. *B1 dimension is a reference dimension for tape feeder clearance only.*
5. *Electronic Industries Association, Standard EIA-481-1.*

Tape Layout

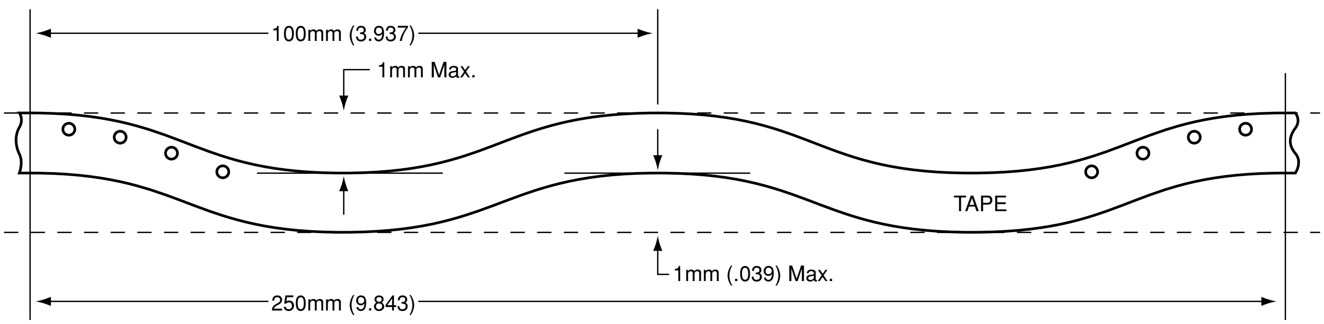
Component Rotation



Bending Radius



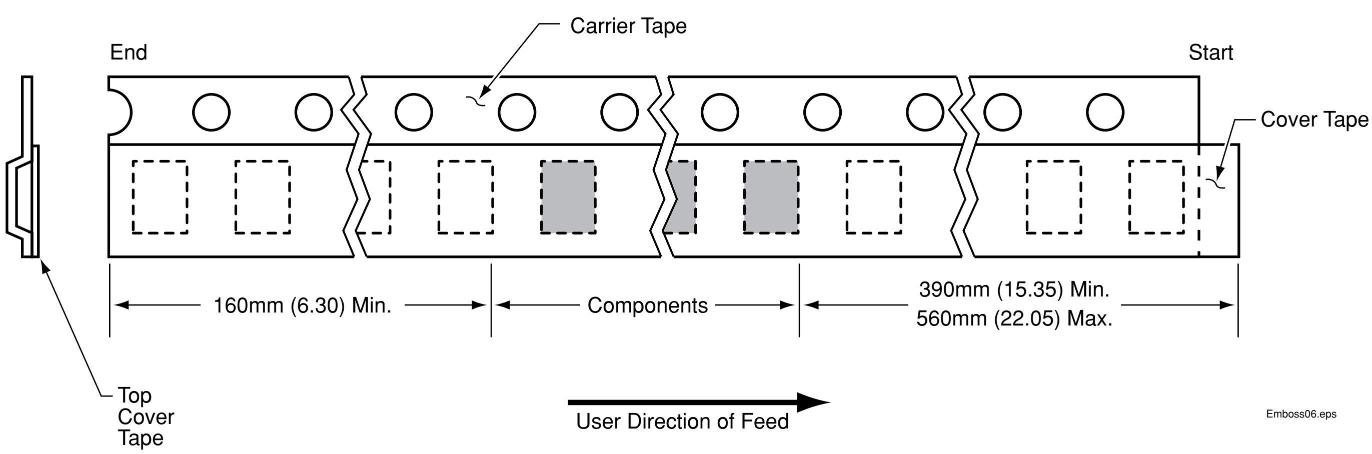
Tape Camber (Top View)



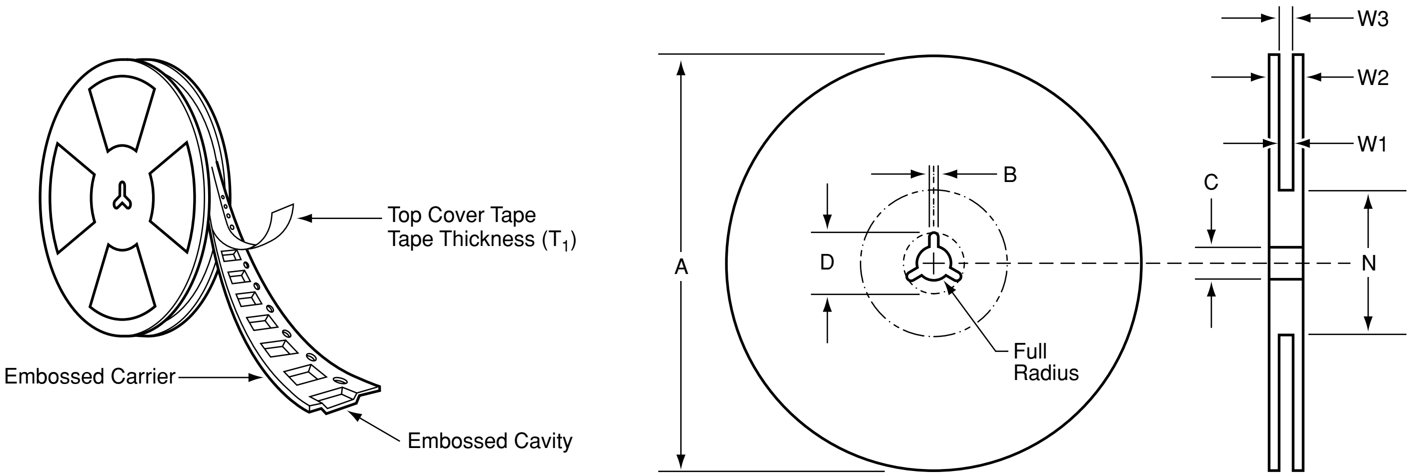
Allowable camber to be 1mm/100mm nonaccumulative over 250mm.

Emboss05.eps

Tape Leader and Trailer Dimensions



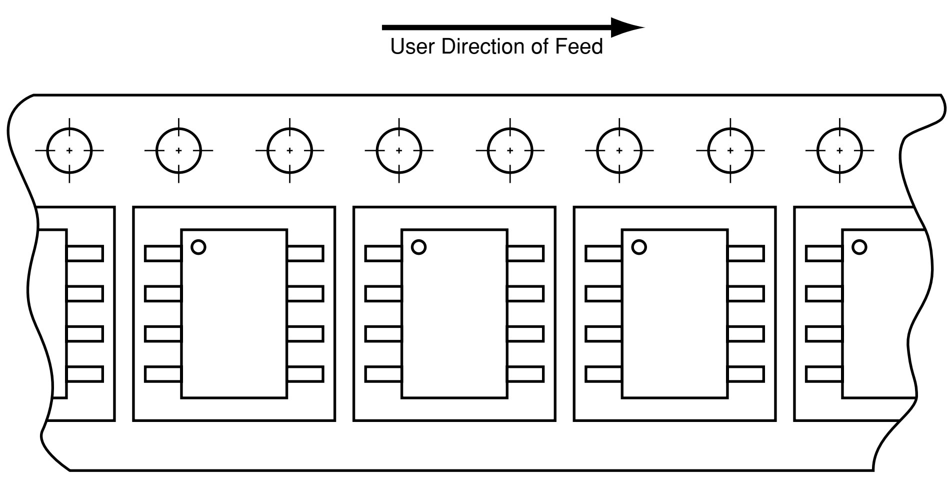
Reel Dimension



Tape Size	A Max.	B Min.	C	D Min.	N Min.	W1	W2 Max.	W3
8mm	330 (12.992)	1.5 (0.059)	13.0 ± 0.20 (0.512 ± 0.008)	20.2 (0.795)	50 (1.969)	$8.4^{+1.5}_{-0.0}$ $\left(0.331^{+0.059}_{-0.0}\right)$	14.4 (0.567)	7.9 Min. (0.311) 10.9 Max. (0.0429)
12mm						$12.4^{+2.0}_{-0.0}$ $\left(0.488^{+0.078}_{-0.0}\right)$	18.4 (0.724)	11.9 Min. (0.469) 15.4 Max. (0.607)

ELD/B_t01.eps

Tape Layout



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Fax: 61.3.9561.2148
E-Mail:
simpson@arwnet.com.au
URL: www.arrow.com.au

169 Unley Rd
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Unley SA 5061
Australia
Tel: 618.232.3922
Fax: 618.232.3929
URL: www.arrow.com.au

17 Bowen Bridge Rd
Unit 43
Herston QLD 4006
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Fax: 61.7.3216.0772
URL: www.arrow.com.au

64 Canning Hwy, Ste. 1
Victoria Park WA 6100
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Fax: 61.9.470.3273
URL: www.arrow.com.au

Level 4, 5 Belmore Street
Burnwood NSW 2134
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URL: www.arrow.com.au

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URL: http://www.tekelec.nl

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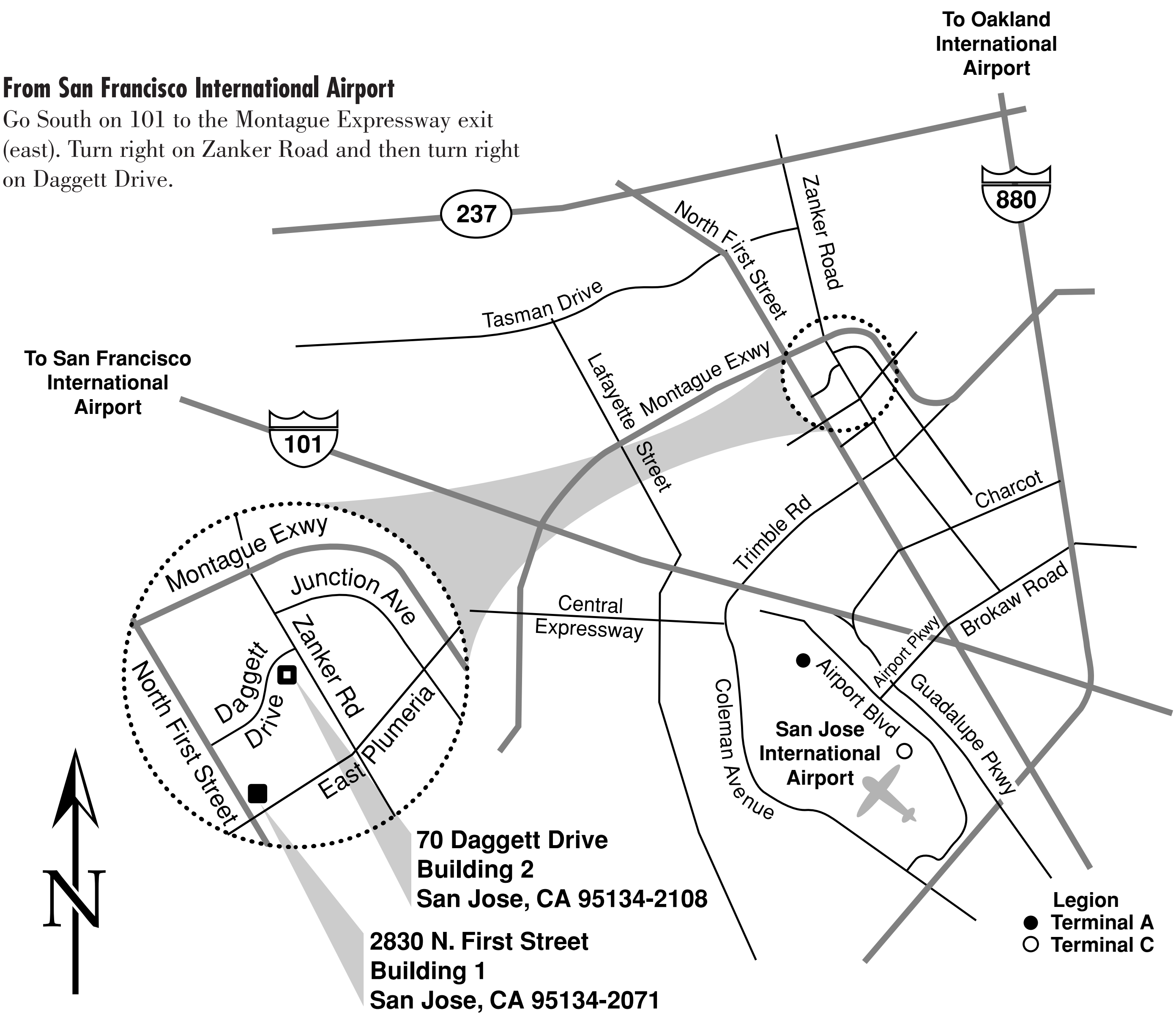
URL:
http://www.sequoia.co.uk

For any location not listed,
please diect inquiries to IMP sales.

From Oakland International Airport
Go South on 880 and turn right at the Montague Expressway exit, move left out of the car pool lane. Turn left on Zanker Road and then turn right on Daggett Drive.

From San Francisco International Airport
Go South on 101 to the Montague Expressway exit (east). Turn right on Zanker Road and then turn right on Daggett Drive.



For Additional Directions
408-432-9100

From San Jose International Airport
From Terminal Drive go to Airport Blvd. From Airport Blvd., turn onto Airport Pkwy. (Airport Pkwy becomes Brokaw Road after 101). Turn left on North First Street, then turn right on Daggett Drive.

Quality Priority

Quality in everything we do is a fundamental IMP commitment. Quality may not be sacrificed for any other priority. Before any action is taken, the effect on quality as seen by employees and by customers must be considered.

Product Quality Conformance

Products and services for our customers will conform to all requirements. Products will meet performance specifications. Services will be complete, meet described requirements, and will be in a format appropriate for the customer's use. If a specification cannot be met in full, the customer will be advised and a new specification will be negotiated.

Product and Process Quality Improvement

All processes, manufacturing, manufacturing planning, customer service, product design and design of manufacturing processes shall utilize Total Quality Management concepts including Statistical Process Control techniques and designed experiments to ensure continual improvement of products and services.

Employee Responsibility

Each employee is responsible for performing their work correctly and completely. This responsibility for quality performance applies to all design work, development work, manufacturing work and to all supporting work. It applies to all employee levels. It cannot be abandoned or delegated. No one else can take responsibility.

IMP's Commitment of Support

IMP will provide the tools, the training, and the time necessary for employees to meet their responsibilities.

Employee Participation

IMP encourages all employees to take part in the open discussion, analysis and resolution of problems through participation in quality and productivity teams or through personal suggestions.

DNV Certification, Inc.

DET NORSKE VERITAS
QUALITY SYSTEM CERTIFICATE

Certificate No. 99-HOU-AQ-8474

This is to certify that the Quality System
of

IMP INC.

at

2830 North First Street, San Jose, CA 95134-2071 USA

Has been found to conform to Quality Standard:

ISO 9001, 1994

This Certificate is valid for the following products/service ranges:

DESIGN AND MANUFACTURE OF ANALOG AND MIXED-SIGNAL INTEGRATED CIRCUITS AND WAFER FABRICATION SERVICES

Place and date:

Houston, Texas; 24 September 1999

for the Accredited Unit:
Det Norske Veritas Certification, Inc.
Houston, Texas, USA
DNV Management System Certification
The Netherlands

Rudy Frueboes
Management Representative
DNV Certification, Inc.

ANSI★RAB EMS QMS ACCREDITED

Accredited by the RvA

This certificate is valid until:

12 August 2002

Initial Certification Date:

08 August 1996

Joseph T. Bosler
Lead Auditor

Lack of fulfillment of conditions as set out in the Appendix may render this certificate invalid.

DET NORSKE VERITAS CERTIFICATION, INC., 16340 Park Ten Place, Suite 100, Houston, TX 77084 USA TEL: (281) 721-6600 FAX: (281) 721-6903

IMP offers higher performance, lower-power microprocessor supervisors that are pin compatible with devices from Dallas Semiconductor and Maxim Integrated Products. For the latest information visit **www.impweb.com** or send specific requests to **info@impinc.com**.

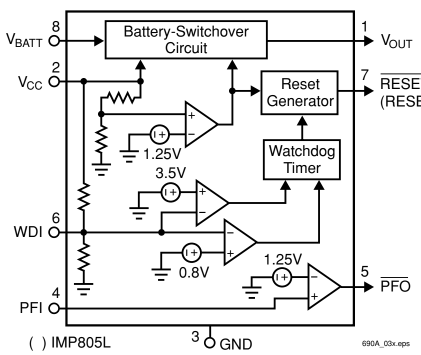
μP Supervisor Products: Low Power Alternatives to Maxim

Part Number	Threshold Voltage (V)	Backup Battery Switch	Watchdog Timer	Power Fail Monitor	Manual Reset	RESET Polarity
IMP690A	4.65	●	●	●		LOW
IMP692A	4.40	●	●	●		LOW
IMP705	4.65		●	●	●	LOW
IMP706	4.40		●	●	●	LOW
IMP707	4.65			●	●	L & H
IMP708	4.40			●	●	L & H
IMP802L	4.65	●	●	●		LOW
IMP802M	4.40	●	●	●		LOW
IMP805L	4.65	●	●	●		HIGH
IMP809	2.63 to 4.63					LOW
IMP810	2.63 to 4.63					HIGH
IMP811	2.63 to 4.63				●	LOW
IMP812	2.63 to 4.63				●	HIGH
IMP813L	4.65		●	●	●	HIGH

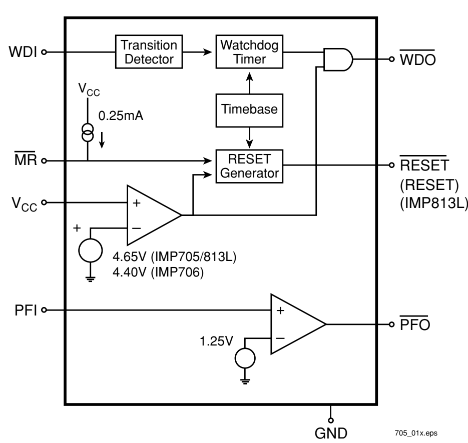
ELD/B_t06

Block Diagrams

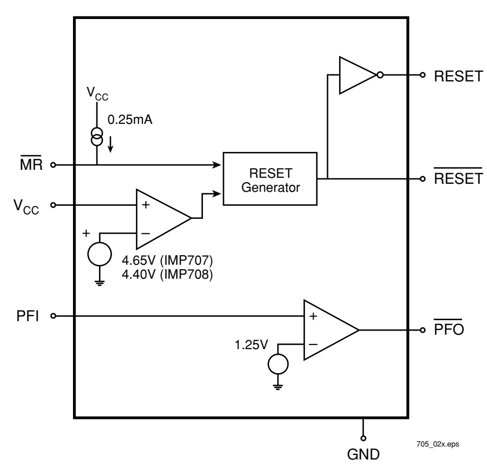
IMP690A, IMP692A, IMP802L, IMP802M and IMP805L



IMP705, IMP706 and IMP813L



IMP707 and IMP708



µP Supervisor Products: Low Power Alternatives to Dallas Semiconductor

IMP Ordering* Part Number	RESET Voltage (V)	RESET Tolerance (%)	RESET Time (ms)	RESET Polarity	Push-Pull Output Stage	Open Drain Output	8-Pin SO Package	SOT-23 Package	SOT-223 Package
IMP1810R-5/T	4.620	5	150	LOW	●			●	
IMP1810R-10/T	4.370	10	150	LOW	●			●	
IMP1810R-15/T	4.120	15	150	LOW	●			●	
IMP1811R-5/T	4.620	5	150	LOW		●		●	
IMP1811R-10/T	4.350	10	150	LOW		●		●	
IMP1811R-15/T	4.130	15	150	LOW		●		●	
IMP1812R-5/T	4.620	5	150	HIGH	●			●	
IMP1812R-10/T	4.350	10	150	HIGH	●			●	
IMP1812R-15/T	4.130	15	150	HIGH	●			●	
IMP1815R-5/T	3.060	5	150	LOW	●			●	
IMP1815R-10/T	2.880	10	150	LOW	●			●	
IMP1815R-20/T	2.550	20	150	LOW	●			●	
IMP1816R-5/T	3.060	5	150	LOW		●		●	
IMP1816R-10/T	2.880	10	150	LOW		●		●	
IMP1816R-20/T	2.550	20	150	LOW		●		●	
IMP1817R-5/T	3.060	5	150	HIGH	●			●	
IMP1817R-10/T	2.880	10	150	HIGH	●			●	
IMP1817R-20/T	2.550	20	150	HIGH	●			●	
IMP1233DZ-5/T	4.625	5	350	LOW		●			●
IMP1233DZ-10/T	4.375	10	350	LOW		●			●
IMP1233DZ-15/T	4.125	15	350	LOW		●			●
IMP1233MS-55/T	4.625	5	350	LOW		●	●		
IMP1233MS-5/T	4.375	10	350	LOW		●	●		
IMP1233MS-3/T	2.720	15	350	LOW		●	●		

** /T indicates Tape and Reel.*

ELD/B_t07

USB Power Switches

IMP offers a full complement of Universal Serial Bus (USB) power switches that are higher-performance equivalents to devices from Micrel.

Part Number	Number of Switches	Open-Load Detection Function	Maximum "ON" Resistance (mΩ)	Enable Polarity
IMP2505	1	YES	50	HIGH
IMP2505-1	1	NO	50	HIGH
IMP2505-2	1	NO	50	LOW
IMP2505-3	1	YES	50	LOW
IMP2524-1	4	NO	140	HIGH
IMP2524-2	4	NO	140	LOW
IMP2525-1	1	NO	140	HIGH
IMP2525-2	1	NO	140	LOW
IMP2525A-1 Low ON Resistance	1	NO	70	HIGH
IMP2525A-2 Low ON Resistance	1	NO	70	LOW
IMP2526-1	2	NO	140	HIGH
IMP2526-2	2	NO	140	LOW
IMP2527-1	4	NO	300	HIGH
IMP2527-2	4	NO	300	LOW

ELD/B_t08

Sample Requests and New Product Updates

Name:

Position:

Company:

Address:

City: State/Province:

Zip Code: Country:

Phone #: Fax #:

Email Address:

IMP Part	Qty
IMP522EMB	
IMP525EMA	
IMP525ESA	
IMP527EMA	
IMP527ESA	

IMP Part	Qty
IMP528EMA	
IMP528ESA	
IMP560EMA	
IMP560ESA	
IMP803LG	
IMP803IMA	

Fax to 408.434.0335

ISO 9001 Registered

www.impweb.com
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April 2001

Printed in USA
Publication #: 2008
Revision: H
Issue Date: 04/13/2001
Type: Production